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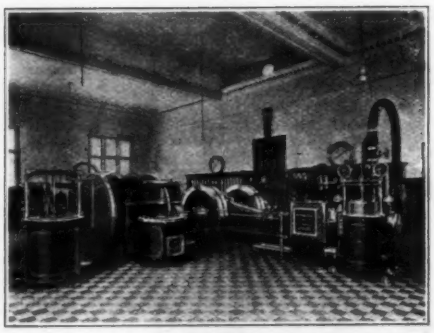

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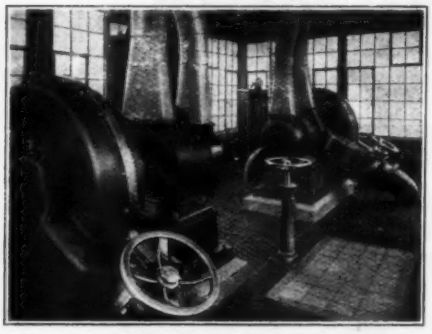

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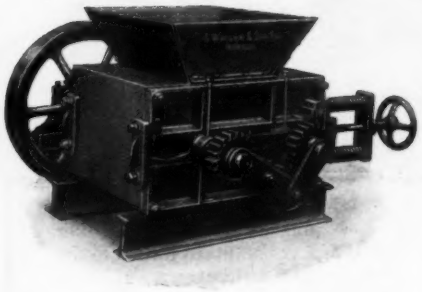

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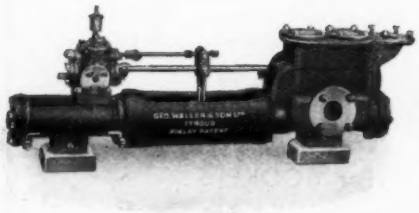

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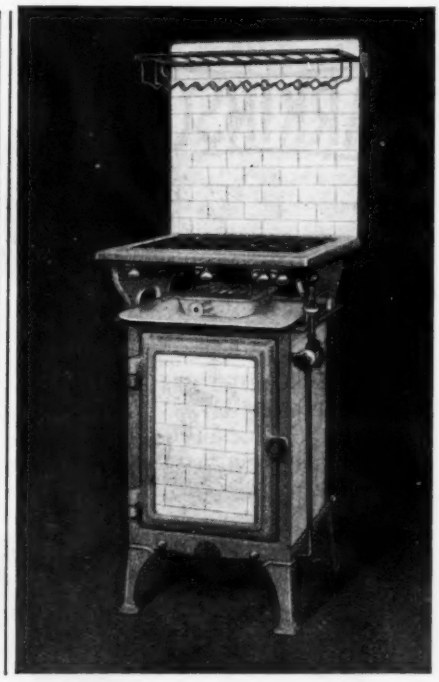

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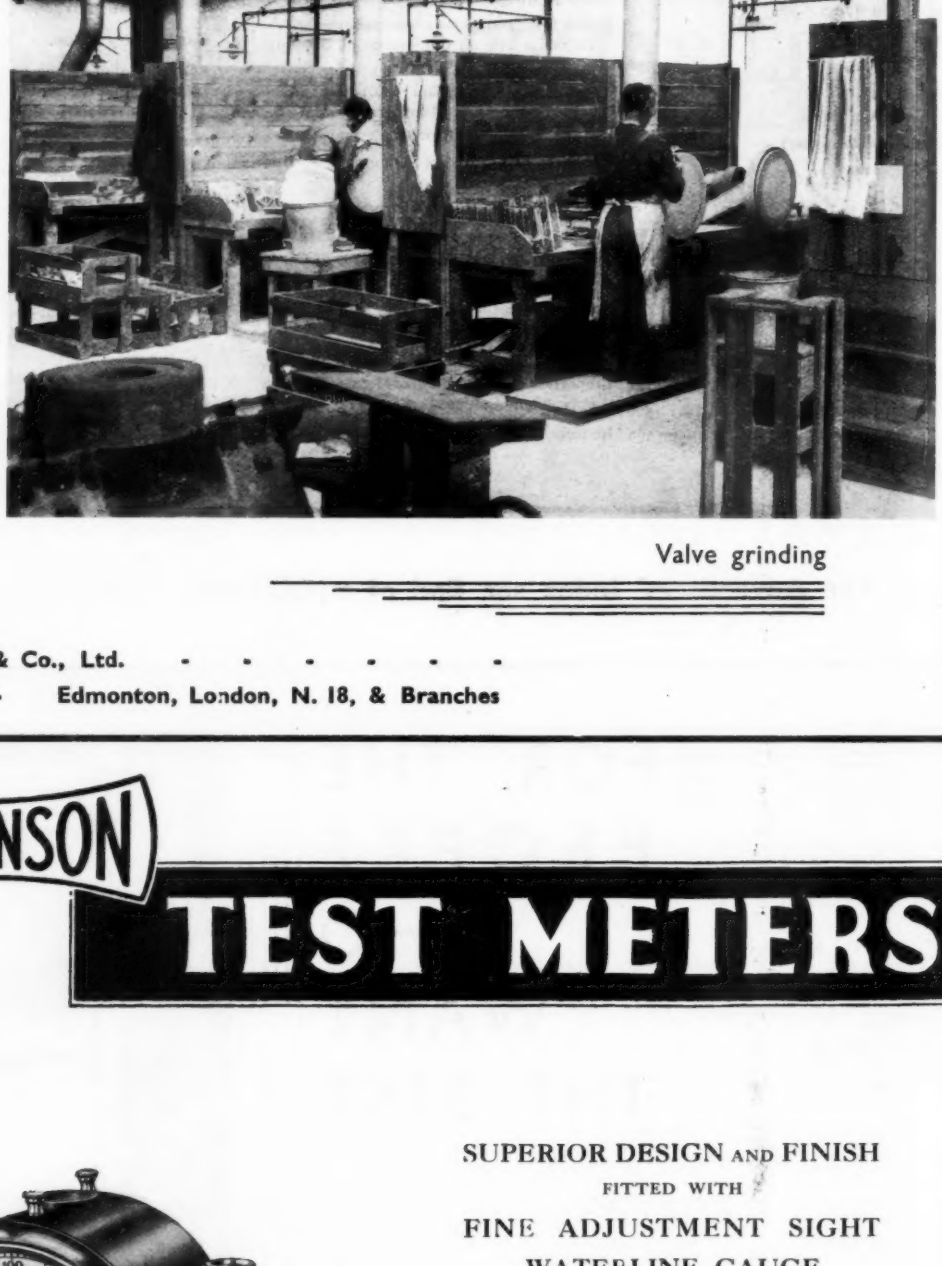

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Gas Journal

SEPTEMBER 11, 1935

Vol. 211. 87th Year No. 3773

Editorial Notes

Busy Times Ahead

THE sudden increase in the bulk of our "Forthcoming Engagements" this week comes as a gentle reminder that the holiday period is all too rapidly drawing to a close, and that the Industry has once more to prepare to put its shoulder to the wheel in the race to keep abreast with modern developments. It is not inappropriate that the "season" opens with the first outward and visible sign of the executive side of the British Gas Federation in the splendid display they are arranging at the Shipping Exhibition, to which we referred last week. This, incidentally, represents the Gas Industry's first official inclusion at this Exhibition.

Then the Association of Public Lighting Engineers have a "gas" President this year in Mr. A. M. Bell, of Tottenham, and their Conference is discussing interesting Papers by prominent members of the Industry, as well as making inspections of gas lighting installations. The month of September also sees meetings of three of our Senior Associations—the North British, the Wales and Monmouthshire, and the North of England—and closes with the Annual General Meeting of the B.C.G.A. under the Presidency of Councillor Walter Muter at Edinburgh. Judging by the programme, this function will be well up to the high standard set by its predecessors, and incorporates contributions by a number of experts on home-planning, kitchencraft, and the commercial side of the business. With the conclusion of September comes the end of the close season for Juniors, which means that regular meetings start in earnest, and technical theses flow in thick and fast from every corner of the country. Then there is an Institution of Gas Engineers Session at the Public Works, Roads, and Transport Exhibition, at which two interesting Papers are to be presented on the use of gas and coke respectively in modern buildings. This Session is to be presided over by the President of the Institution, Colonel W. M. Carr.

And all this fare is the precursor of the Institution Autumn Research Meeting which is to be held at the Institution of Mechanical Engineers on Nov. 5 and 6. So there is no denying that there are busy times ahead for all of us. We have no need to commend these manifold technical gatherings to the attention of the gas executive. But, while the individual gas engineer or manager will undoubtedly endeavour so far as he is able to support the meetings in person, he will on occasions be too much concerned with the record outputs which are going to be attained this winter to spare the time involved in attending. He can in such circumstances continue to rely upon the "JOURNAL" to carry on the task it has set itself during the past four score and more years, and which indeed the Industry expects of it, of passing on the complete record of everything which makes for the progress of our great national utility.

The "Woman" Business

THIS little reminder that, all over the country, engineers, managers, and their staffs are reluctantly returning from holiday and preparing to face a new season, leads us to wonder what new schemes will be launched in the next month or two; what publicity and other campaigns to combat the too prevalent idea that to be "modern" one must be "electric."

Enquiries lead us to believe that the Women's Gas Council, which was formed a few months ago, will be in the news in this respect, and we suggest to all who have not yet done so that they give serious consideration to the advantages of making a real live movement out of "this woman business." It obviously takes two to co-operate, and now that it is generally known that the Council is ready to be a co-operator of the one part, we cannot see why any individual undertaking should hesitate at least to investigate what it is likely to obtain by joining hands.

Meanwhile we have every reason to believe that the Council's offer of assistance has been quite enthusiastically accepted by a number of undertakings, and it will be interesting to see who are first in the field with the formation of branches. Will it be the same units of our Industry which can always be relied upon to be go-ahead and far-seeing, or will the movement prove the means of bringing into the forefront some of the hitherto less venturesome ones, who will see in it an opportunity to show that they are alive to the importance of getting at the consumer's point of view?

At all events enquiry into possibilities can do nobody any harm, and this is what we sincerely recommend. If there is satisfaction with the result of such enquiry, then the movement will provide a unique opportunity in which all types of undertaking can participate. Those who have already done a great deal on the women's side and can claim to be pioneers in this sphere may well find in the Women's Gas Council a way of crowning their work by establishing locally a permanent body of women whose confidence has already been won and who can now be used in an advisory capacity. On the other hand those who for lack of opportunity or initiative have shelved this side are now given a chance to begin at the other

end, and by means of a local women's association find out what the women really want and need. In any case we cannot see anything to be gained by an attitude of sitting on the fence and waiting to see what the next-door neighbour is going to do about it—an attitude which we fear is not unknown upon other matters besides the one under discussion. "Nothing venture nothing have" is an old adage which is as true to-day as ever.

Lady Demonstrators

In this consideration of a new departure we do not forget the splendid work which the B.C.G.A. have done, and are continuing to do, in cultivating a right outlook on this important aspect of domestic sales. Sir Francis Goodenough has for years stressed the necessity of realizing that, whoever pays, the woman has a big say in the equipment of the home, and more recently Mrs. Eileen Murphy has indefatigably carried the banner to all corners of the land. But there is no overlapping, as far as we can see, between the work of the Home Service Section of the Association and that of the W.G.C., so that we can safely appeal for support for both of them. The former has arranged a section of its own of the programme at the Edinburgh Conference. We have reason to believe that the intrusion of the mere male into the discussion on "Training for Home Management" will not be regarded as gate-crashing, but, on the contrary, will be heartily welcomed. We suggest an intrusion in force.

While on the subject of the ladies—to whom, ungallantly perhaps, we may be unable to devote another article during the next few weeks—we would say one word on the question of demonstrators. There appears, strangely it seems to us, to be a definite shortage of people to form this extremely useful link between the gas undertaking and the consumer. Some say that undertakings will not pay enough to attract the right personnel; others that personnel worth paying is not available. But it does seem to us that if recognized training and qualifications were readily available it would be well worth the Industry's while to recognize a sufficiently attractive rate of remuneration to bring in the right type of personnel, and that the shortage would thus be remedied. Without being able to decide whether such training should be the function of the B.C.G.A., or might be undertaken by the Women's Gas Council or elsewhere, we commend the whole question to the consideration of the Association, because in our view the demonstrator, both in the showroom and on the district, is a most important link.

Research

In recent issues we have made reference to the splendid Silver Jubilee Number of *West's Gas*, further thoughts upon which lead more than ever to a realization of the fine spirit which animates the contracting side of the Industry, and the good fortune of the Industry in being so well served in this respect. The contributions by the heads of several firms have combined with those from the other side of the Industry to make an outstanding success of this particular issue of the House Organ of one of their number, and it is clear from their quality that they have been ungrudgingly given. One of these articles, in fact, constitutes a veritable "scoop" which, it is safe to say, will have been the envy of a very considerable number of editors of gas papers in this country. We refer to "Industrial Gas," by Dr. E. W. Smith, C.B.E.

Mr. John Terrace, reviewing the issue in our columns last week, remarked: "All who have, or hope to develop, an industrial load, will turn eagerly to Dr. E. W. Smith's article on 'Industrial Gas,' but lest any should not have sufficient interest in designs of furnaces, controlled and special atmospheres, and such details, to continue their reading to the end, the writer would recommend them not to miss the last part which deals with the questions of research, testing, and the suggestions made by Messrs. Lacey and Masterman in their Paper to the Institution this year." The Industry has long since come to look for ideas and original thought from Dr. Smith, and we ourselves were doubtful, when reading the earlier part of the article dealing with the technical details to which Mr. Terrace refers, whether the author would be able to continue to the end in quite the same strain, and without permitting himself just a slight variation from the stereotyped. It is to the last part of the article, which Mr. Terrace urged his readers not to miss, that we refer as a "scoop," because it is a frank expression of opinion, by no less outspoken a man than Dr. Smith, on a subject of such vital moment to the Industry as research. The views he expresses may not be universally popular nor prove immediately acceptable—Dr. Smith is the last man to expect this—but in our opinon they should certainly be aired, if only because they propose quite startling changes from current practice, and they should also be given every consideration on merit, because they most likely reflect, to a large extent, the feelings of quite an influential section of the Industry. By courtesy of the Editor, and for the benefit of those who may not have been fortunate enough to see a copy of *West's Gas*, we reproduce on later pages what may be termed the controversial portion of Dr. Smith's article.

The Concern of All

Shorn of detail, which after all would be a matter for later decision and in the meantime tends to obscure consideration of main principles, Dr. Smith's contention is that the control of research in the Gas Industry should be much more widely held than it is at present. He claims, in effect, that the whole Industry is vitally interested in research, and that therefore the whole Industry should have the opportunity of an effective share in its control. He points out that none of the older national bodies—neither the Institution, nor the N.G.C., nor the B.C.G.A. —is truly representative of the *whole* Industry, and seeing that, fundamentally, the development of the utilization of gas is the concern of all—both undertakings and "makers" alike—it seems to him that the British Gas Federation is the only proper body to control it.

Here, at all events, is food for thought by those who ask what use the Industry is going to make of its Federation. But, to complete Dr. Smith's story, he does not suggest that the B.G.F. should undertake research directly, but that it should put gas on a par with other industries by sponsoring the formation of a British Gas Industry Research Association, which would be financed from the central bodies' general fund. In addition to this, Dr. Smith appears to have little doubt that the Treasury, through the Department of Scientific and Industrial Research, would subscribe to it as it does to the research associations run by other industries, and he gives more than a hint that still further grist should come to the mill through the Society of British Gas Industries if, in the manner he suggests, the contracting side of the Industry had a fair share in the control.

Dr. Smith elaborates his suggestions with interesting detail, and even with examples of subjects which many will agree are deserving of attention, and which might well receive the attention they merit under the wider scheme which he advocates. But we have purposely concentrated on what we believe to be the main theme of the article, knowing that it will receive every consideration

by all who are interested in the welfare of the Industry. Speeches in Parliament are not the only occasions adopted by Cabinet Ministers for important declarations of policy; similarly in his article in *West's Gas* we do not believe Dr. Smith would have spoken " without the book " concerning the possibility of the S.B.G.I. playing their part in the very important realm of research. It is for the rest of the Industry to decide whether they will accept such assistance, and also try for the Treasury grant of which Dr. Smith speaks. In this matter, also, we have little doubt Dr. Smith is sure of his ground. .

External Corrosion of Pipes

By the courtesy of The Institution of Gas Engineers we are able to publish in this issue the results of some exceptionally interesting work on what is one of the most serious technical problems which the Gas Industry constantly has to face. A " Report on Protective Coatings for Underground Pipes," by A. B. Densham and F. C. Smith, constitutes Publication No. 115, in the familiar " blue-book " form, which will be presented to the Autumn Research Meeting in London in November.

Though any discussion of the contents of the Report in our columns at this stage would constitute a breach of privilege, we may permit ourselves to commend the extremely valuable nature of the contents, the interesting manner in which they are set out, and the concise method of recording the findings. The authors are to be congratulated on obtaining positive results which quite obviously must have entailed a vast amount of patience and hard work, and the Industry will warmly commend the action of the Institution in placing the Report at general disposal at the earliest available moment. Copies are obtainable from the Institution in the usual way.

" The Gas-Works " (Laughter)

It has been stated that every novel is based upon one of six stories. So also, the comedian's unfailing prescription for the production of laughter is to mention one of six themes: Wigan Pier, Manchester's rain, mothers-in-law, Aberdonian generosity, seaside landladies—or the GAS-WORKS. It is difficult to understand why a gas-works is still a subject which is regarded as comical—possibly the perennial pleasantry has a propaganda value like Mr. Ford's famous stories of his equally famous cars.

This subject came to mind through an article in a contemporary published not 100 miles from London which sent a reporter and a photographer to get a glimpse behind their city life. The water pumping station was written up as an example of impressive power. The electricity station suggested quiet efficiency like the engine room of a battleship—" Everything is spick and span, the metalwork is polished until it resembles silver—not a thing is out of place. The silent efficiency is almost awe-inspiring. Experts walk round the generating rooms quietly and without hurry, but with eyes and ears always alert." But the reporter evidently thought his article was becoming highbrow, so he went to the gas-works to introduce his humorous stuff. Here it was manifest that " extracting gas from coal necessarily makes for dust, heat, smoke, and noise. But efficiency is there just the same." The tour of the intrepid reporter and photographer is described in detail—how the latter climbed under red-hot plates (*sic*) in the retort house in order to secure exclusive photos—how Dante's Inferno would be regarded by the writer as a refrigerator. And the workmen who stick the gas-works temperatures in a heat wave are He-men, with a capital H ! Having seen the " fearsomely fascinating " process of dropping " white hot coke " into a bucket which soon became a " cauldron of steam " under a giant water cooler, the reporter leaves the subject of gas manufacture as the bucket sails away into the air in a telpher to " shoot its contents into a mighty sieve."

The moral of this story is simple. Visits to well-laid-out gas-works designed with great attention to architectural considerations, carefully planned showrooms, artistic fittings, good service to the consumer and skilful Press propaganda on the advantages of gas—each in its way is helping to correct the minds of the general public from believing that gas manufacture must necessarily be a dirty, noisome process and that gas itself is an anachronism which for the time being must be tolerated. But there is still a deal of educating to be done.

Joy-Riding Conferences

Some of our readers will surely have taken to heart the protest which was voiced at a meeting of a provincial town council in connection with their delegates' attendance at the recent conference of a certain professional body. To quote the words of the delegates' report which gave rise to the criticism: " Out of five clear days there was only one meeting. The rest of the time was taken up by being entertained, luncheons and banquets, viewing racehorse stables, and joy-riding on the river. The conference cost the ratepayers £30." One cannot but observe the note of disapproval which is ill-concealed in this last terse statement. That such remarks, however, should have come from one of those who actually attended the conference is strange, unless, of course, the complainant's liver was suffering from the aftermath of so excellent a gathering. There were two delegates from this particular town, so on a similar basis it is to be presumed that a tolerably good time was had by all at £3 per head per diem. Indeed, we are tempted to make early application for tickets for their next conference, for which, after this doubtless unwanted publicity, there will be a rush.

That the Association in question seems sucessfully to have solved the problem of combining business with pleasure is apparent; but the councillor's laconic comment that such conferences should be blacklisted will fail, we are sure, to find ready support. Human nature being what it is, the business gathering which is devoid of social intercourse will be but sparsely attended, and consequently of little value to the profession it sets out to serve. But the practice of taking a few days off " at the firm's expense " ostensibly to attend a conference of one's business associates, in reality to divide the time between an organized round of entertainment and a close attention to the inner man is apt to throw both delegate and profession into ill-repute—however unfounded. While hesitating to draw invidious comparisons between our own and other professional bodies, it will be generally conceded that the Gas Industry invariably maintains a happy balance between business and pleasure; and if the gas engineer regards such meetings as a " holiday," at least he can have the satisfaction of appending that useful epithet " busman's " to it with the sure knowledge that no one will gainsay him.

No; we feel that, with all due sense of proportion, the amount of " rough-riding " through the technical discussions which constitute the *raison d'être* of these gatherings calls in these strenuous days for some " joy-riding " as well. We need it. At any rate, the Gas Industry, while it has at times been known to stage a banquet and cannot even plead entire innocence of that insidious pastime of joy-riding on a river, has so far as we are aware succeeded in avoiding the temptation of so risky an outing as a visit to a racing stable.

Personal

We learn that Colonel W. MONCRIEFF CARR, O.B.E., T.D., has been appointed a Director of the United Kingdom Gas Corporation.

* * *

Mr. A. E. GRINDROD, who has retired after 53 years' service with Messrs. Clapham Bros., Gas Plant Manufacturers, Keighley, has been presented with a clock.

* * *

Colonel O. B. F. PLANCK, D.S.O., D.L. (Local Director Messrs. Stewarts & Lloyds, Ltd.), has been awarded the Territorial Decoration. He is still on the Active List (Unemployed) of the Territorial Army. He also received the King's Silver Jubilee Medal last May.

* * *

Messrs. Scott & Manwaring announce that they have taken into partnership Mr. ALBERT ERNEST SCOTT, the son of their Senior Partner, Mr. W. A. Scott, F.C.A., J.P. The name and constitution of the firm will otherwise remain unchanged.

* * *

An interesting presentation took place at Dalmarnock Gas-Works, Glasgow, on Sept. 5, on the occasion of the retirement of the Manager, Mr. J. K. FRAZER. The presentation took the form of a canteen of cutlery for Mr. Frazer and a silver bowl and salver for Mrs. Frazer, and was made by Mr. J. W. McLusky, General Manager of the Glasgow Corporation Gas Department, who was introduced by Mr T. G. Moffat, Manager of Tradeston Gas-Works. Mr. McLusky, in making the presentation, said that though his was a pleasant duty it was mixed with feelings of regret. No one liked making a break, but it was some satisfaction in saying good-bye to see a man in such good health and so well able to enjoy his well-earned retirement.

Mr. Frazer, in reply, said that it was strange that a man in his youth should be called upon to retire. He felt, however, that he would enjoy his retirement. He had always preached loyalty to one's chief and truth at all times without fail. He was leaving without any qualms of work undone and he felt that he had been straight and honourable to every man. He had been 21 years in Dalmarnock and the first 10 years from the opening in 1914 had been very strenuous. He did not require anything to remind him of his days in Dalmarnock, but the gifts which he and his wife had received would remind him of the good wishes of those he was leaving. Among others who spoke in appreciation of Mr. Frazer were Mr. J. MacLeod, Manager of the Glasgow Corporation Chemical Department, Mr. Ralph Milne, Manager of Provan Gas-Works, Mr. R. Sturrock, Engineer and Manager, Ardrossan, and Mr. A. Whitelock.

Institution of Gas Engineers

Session at the Public Works Congress and Exhibition

The 8th Public Works, Roads, and Transport Congress and Exhibition will be held at the Royal Agricultural Hall, London, N. 1, from Nov. 18 to 23 next.

Members of The Institution of Gas Engineers will receive Admission Tickets to the Congress and Exhibition and they are particularly requested to attend the Institution's Session—at which the Chair will be taken by the President, Colonel W. Moncrieff Carr, O.B.E., T.D.—on Tuesday, Nov. 19, at 3 p.m., when the following Papers will be presented and discussed:

"Gas Utilization in Modern Buildings," by Dr. F. M. H. Taylor, Ph.D., B.Sc., A.R.C.S., M.I.H.V.E., M.Inst.F. (Gas Light and Coke Company).

"Coke Utilization in Modern Buildings," by Mr. W. I. Boon, M.I.Mech.E. (Manager, London and Counties Coke Association).

Members desiring to register as Delegates to the Congress and Exhibition—the fee of one guinea for which includes an advance copy of all Papers to be presented and a bound copy of the Congress Proceedings—should communicate with the Hon. Secretary to the Congress (Mr. S. M. Johnson), at 84, Eccleston Square, London, S.W. 1.

Copies of the above-mentioned Papers by Dr. Taylor and Mr. Boon may be obtained, price 1s. each including postage, from the Secretary of The Institution of Gas Engineers.

Protective Coatings for Underground Pipes

The Institution of Gas Engineers has published a "Report on Protective Coatings for Underground Pipes," by A. B. Densham, M.A., and F. C. Smith, Assoc.M.Inst.Gas E. (see later pages of this issue). Copies of the complete Report in "blue book" form (Communication No. 115) are obtainable, price 1s. 6d. each, including postage, from the Secretary of the Institution, at 28, Grosvenor Gardens, London, S.W. 1.

Shipping Exhibition

The Council of The Institution of Gas Engineers will be entertained by the Organizers at Luncheon and members at Tea on the occasion of the customary Official Visit of the Institution to the Shipping, Engineering and Machinery Exhibition, at Olympia, London, on Tuesday, Sept. 17, 1935.

British Standard Specifications

The following British Standard Specifications have recently been issued, and copies may be obtained, price 2s. each, from the Secretary, The Institution of Gas Engineers, 28, Grosvenor Gardens, London, S.W. 1: Identification of Pipes, Conduits, Ducts, and Cables in Buildings (No. 617-1935), Colours for Signal Glasses for Railway Purposes (No. 623-1935), and Plano-Convex (Bullseye) Lenses (No. 624-1935).

Forthcoming Engagements

Sept.

12.—NORTH BRITISH ASSOCIATION.—Annual Meeting at St. Andrews.
12.—Shipping, Engineering, and Machinery Exhibition opens at Olympia.
17.—I.G.E.—Council Luncheon at Shipping Exhibition.
19.—I.G.E.—Refractory Materials Joint Committee, 2.30 p.m.
19.—WALES AND MONMOUTHSHIRE ASSOCIATION.—Autumn Meeting at Porthcawl.
19.—S.B.G.I.—Council Meeting at 11 a.m.
20.—NORTH OF ENGLAND ASSOCIATION.—Autumn Meeting at Whitby.
20.—SOUTHERN ASSOCIATION (WESTERN SECTION).—Commercial Meeting at Dartmouth.
26.—I.G.E.—Joint Lighting Committee, 2.30 p.m.
27.—I.G.E.—Liquor Effluents and Ammonia Committee, 11.15 a.m.; Joint Research Committee, 2.30 p.m.
28-Oct. 1.—B.C.G.A.—Annual General Meeting and Conference at Edinburgh.

Oct.

4.—I.G.E.—Research Executive Committee, 2.30 p.m.
7.—I.G.E.—Finance Committee, 1.45 p.m.; Membership Committee, 1.45 p.m.; General Purposes Committee, 3.15 p.m.; Benevolent Fund Committee of Management, 4.30 p.m.
8.—I.G.E.—Council, 10 a.m.; Gas Education Committee, 4 p.m.
9.—I.G.E.—Gas Education Executive Committee, 10 a.m.; Council, the British Gas Federation, 10.30 a.m.; Board of Examiners, 2.30 p.m.
17.—B.C.G.A.—Midlands District Conference at Wolverhampton.
17.—EASTERN COUNTIES ASSOCIATION.—Autumn Meeting at the Stanton Ironworks Company, near Nottingham.
17.—SOUTHERN ASSOCIATION (EASTERN DISTRICT).—Meeting at 28, Grosvenor Gardens, S.W. 1.
19.—SCOTTISH JUNIOR ASSOCIATION (WESTERN SECTION).—Visit to Messrs. Thomas Glover & Co., Ltd., Edmonton.
29.—B.C.G.A.—Eastern District Conference at Peterborough.

Nov.

4.—B.G.F.—1st Annual General Meeting, Grosvenor House, Park Lane, London, W. 1, 3 p.m.; 2nd Annual Dinner, Grosvenor House, Park Lane, London, W. 1, 7 p.m.
5.—I.G.E.—Council, 9.30 a.m.; Council, 4.30 p.m.
5 and 6.—I.G.E.—7th Autumn Research Meeting at The Institution of Mechanical Engineers, Storey's Gate, St. James' Park, S.W. 1.
12.—I.G.E.—Gas Education Executive Committee, 6 p.m.
14.—MIDLAND ASSOCIATION.—Autumn General Meeting, Grand Hotel, Birmingham.
19.—I.G.E.—Session at the 8th Public Works, Roads and Transport Congress and Exhibition, Royal Agricultural Hall, London, N. 1, 3 p.m.
29.—I.G.E.—Liquor Effluents and Ammonia Committee, 11.15 a.m.; Joint Research Committee, 2.30 p.m.

Dec.

3.—I.G.E.—Research Executive Committee, 2.30 p.m.

News in Brief

First and Fifth Prizes were gained by the Taunton Gas Light and Coke Company in the trade vehicles class at Taunton Carnival on Aug. 31.

An Extension of Limits of Supply is one of the objects of a Special Order for which the Winsford Urban District Council intend to apply to the Board of Trade.

The Commercial Meeting of the Southern Association of Gas Engineers and Managers (Western District) will be held at the Royal Castle Hotel, Dartmouth, on Friday, Sept. 20, at 2.45 p.m.

Alteration of Calorific Value.—Notice is given that the Oxford and District Gas Company intend altering the declared calorific value of the gas supplied by them from 450 B.Th.U. to 460 B.Th.U. from Dec. 4, 1935.

A Special Order with the object *inter alia* of empowering the Wellingborough Gas Light Company, Ltd., to purchase the Undertaking of the Irthlingborough Gas and Coke Company, Ltd., is to be applied for to the Board of Trade.

A Reduction in the Price of Gas of 2d. per 1,000 cu.ft. was agreed upon at the monthly meeting of Helensburgh Town Council. This makes the new price 1s. 11d. per 1,000 cu.ft. Last year the Gas Department showed a surplus of £2,524.

Application for a Special Order under the Gas Undertakings Acts, 1920 to 1934, is intended to be made to the Board of Trade by the Newton-in-Makerfield Urban District Council with the object *inter alia* of authorizing the Council to operate Gas-Works plant on certain land.

The Swiss Association of Gas and Water Engineers held its 62nd annual congress at Interlaken from Aug. 31 to Sept. 8 last. Among the Papers read at the meeting was one on "Problems Connected with the Erection of a 3½-Million cu.ft. Gasholder at Zurich" by Prof. Dr. Karno.

By 15 Votes to 8 Dundee Town Council decided on Sept. 5 to light Perth Road, from Miller's Wynd westwards, by gas in preference to electricity. The Police and Lighting Committee recommended the use of 76 four-light gas lanterns, to cost £297, with annual maintenance cost of £230.

The Next Meeting of the Southern Association of Gas Engineers and Managers (Eastern District) will be held at The Institution of Gas Engineers, 28, Grosvenor Gardens, S.W. 1, on Thursday, Oct. 17, 1935, at 2.30 p.m. The subject for discussion will be "The Gas Industry and the Future."

The Half-Yearly Meeting of the Eastern Counties Gas Managers' Association will be held on Thursday, Oct. 17, at Stanton, nr. Nottingham, where, by courtesy of the Stanton Ironworks Company, arrangements have been made to inspect the spun pipe and concrete pipe works of the Company.

A General Meeting of the Wales and Monmouthshire Association of Gas Engineers and Managers will be held on Sept. 19 at the Grand Pavilion, Porthcawl. At the conclusion of the usual business of the meeting a Paper will be presented by Mr. A. T. Green, F.I.C., Assistant Director of the British Refractories Research Association.

A Breakdown at the Power Station deprived users of electric power of their source of light in Guernsey recently and there was the inevitable rush for candles. Gas lighting was the source of much gratification to those fortunate enough to possess it with the exception of one grocer who was absolutely baffled by the phenomenal run on his candles!

An All-Gas Kitchen, claimed to be the largest of its kind, is to be installed by the Tottenham and District Gas Company at the Alexandra Palace for the Trustees. This will cater for the thousands of visitors that the Palace receives each week, and will also provide meals at the time of exhibitions, such as the forthcoming North London Exhibition.

The Progress of St. Helens Gas Department is reviewed in a brochure recently published by the Corporation in connection with the Centenary of Local Government. The first works for the supply of gas to St. Helens were erected a little over a century ago by the St. Helens Gaslight Company and supplied gas at 10s. 6d. per 1,000 cu.ft. Some 42 years later the Undertaking was purchased by the Corporation, the plant at that time being capable of producing 546,700 cu.ft. per diem. With the completion of the plant now in course of erection the Undertaking will be in a position to maintain an output of 5 million cu.ft. per day.

An Order has been received by Messrs. C. & W. Walker, Ltd., Gas, Chemical, and Constructional Engineers, Midland Iron Works, Donnington, nr. Wellington, Shropshire, from the Municipal Council of Johannesburg for one new large spiral gasholder and extensions to two existing large holders, against world-wide competition.

"**Gas in the Homes of To-Day**" forms the subject of an article contributed to the Building and Allied Trades Supplement of the Monthly Journal of the Newcastle-upon-Tyne and Gateshead Chamber of Commerce by the Newcastle-upon-Tyne and Gateshead Gas Company. There is also published, on a subsequent page, a cross-page illustration showing the Company's magnificent showrooms.

Radiation Dividend.—The Directors of Radiation Limited have declared an interim dividend on the ordinary shares of 7½d. per share (3⅛% actual), less tax, and an interim dividend on the 6% cumulative preference shares of 3% actual, less tax, for the half-year ended June 30, 1935. Dividend warrants will be posted on Oct. 12, 1935, and the Transfer Books for both classes of shares will be closed from Sept. 9 to 21, both days inclusive.

The Following Prices have been fixed by the Lanark County Council for the year ending May 15, 1936: All gas supply districts—Ordinary meters, 1s. 1½d. per therm, or 4s. 6d. per 1,000 cu.ft.; prepayment meters, 1s. 3¾d. per therm, or 5s. 3d. per 1,000 cu.ft. The gas contingent guarantee rate to be imposed within the combined gas supply area for the current year is 5d. per £1. Any deficiency in the present year's revenue account will be met out of the balance in hand in the repairs, renewals, and depreciation fund.

Application for a Provisional Order has been made to the Northern Ireland Ministry of Commerce by Coleraine Borough Council to enable them to supply gas to the town of Portstewart, a growing seaside resort six miles distant. Mr. F. G. McElwee, Engineer and Manager, informed the Council that a canvass of the householders in Portstewart had been made and 65% of them were definitely in favour of gas. The Council's application is backed by Mr. J. D. Smith, Engineer, Manager, and Secretary, Belfast Gas Department, who has advised that the proposal would be a paying proposition in about three years' time.

Copies of the Papers, "Modern Views on Street Lighting and their Relation to Visibility," by Mr. F. C. Smith, F.C.S., Assoc.M.Inst.Gas E., and Mr. K. F. Sawyer, B.Sc. (Gas Light and Coke Company), and "Some Notes on Street Lighting Problems and on Directional Gas Lighting," by Mr. Dean Chandler and Mr. A. J. Prestage, B.Sc. (South Metropolitan Gas Company), presented at the 12th Annual Meeting and Conference of the Association of Public Lighting Engineers in London to-day, can be obtained, price 6d. each, including postage, from the Secretary of The Institution of Gas Engineers, 28, Grosvenor Gardens, S.W. 1.

A Two-Part Tariff for gas consumers was recommended on Sept. 2 at a meeting following a tour of the Works by a special sub-Committee of the Lanarkshire Gas Committee. Mr. Owen Coyle, Convener, presiding, said that the sub-Committee had been formed to try to find means of increasing the consumption of gas throughout the county. At Uddingston and Cambuslang they had two most efficient Works, and under ordinary circumstances they could manufacture and distribute gas as cheaply as anyone. Mr. Macleod said that the way out of the difficulty was to have a two-part tariff on the principle that when a consumer had taken sufficient gas to pay his proper quota of the capital charges he would be allowed a substantial concession in the matter of price.

Gas to Continue at Inverkeithing.—At the monthly meeting of Inverkeithing Town Council on Sept. 5 it was reported that the Streets Committee had resumed consideration of the Inverkeithing Gas Company's proposal for the renewal of their agreement. The Committee were of the opinion that the reduction in price offered by the Company was insufficient, and instructed the Town Clerk to reply to this effect. At a subsequent meeting a letter was submitted from the Chairman of the Gas Company pointing out that the reduction proposed by the Committee was impossible. On Aug. 8 the Committee met the Directors of the Company, and after hearing the Chairman's explanations it was considered that the terms now proposed were as favourable as could be expected, and agreed to recommend acceptance by the Council.

Amalgamation and Grouping

United Kingdom and Scarborough.

Acceptance has been intimated by holders of a majority of the stock of the Scarborough Gas Company of the recent offer of the United Kingdom Gas Corporation to acquire the Undertaking provided that a minimum of 51% of the stock was sold or transferred to the Corporation.

British Commercial Gas Association

Yorkshire District Conference at Bradford

The Yorkshire District Conference of the B.C.G.A. was held in Bradford on Thursday, Sept. 5, 1935, under the Presidency of Alderman F. J. Cowie, Chairman of the Bradford Gas Department.

The delegates were welcomed by the Lord Mayor, Alderman Walter Hodgson, J.P. An Address was then delivered by Alderman Louis F. W. S. Smith, J.P., Chairman of the Bradford Health Committee.

The eminent physician, Sir Bruce Bruce-Porter, K.B.E., C.M.G., M.D., in the course of his Address on "The Home," referred to the contrast between the house of to-day, fitted with gas for heating purposes and for refrigeration, and the average house of 50 years ago where the shortage of hot water meant hard work in cleaning greasy pots and dishes. It was becoming almost a routine thing in new houses to install gas heating and when he last spoke for the Association at Worcester he had a striking demonstration of the crime of the smoky chimney. Sir Francis Goodenough and he had to make the journey to town *via* Birmingham. It was a lovely sunny day and the skies clear—no smoke showed from the chimneys of the new houses on the outskirts of the city, but he had counted some half-dozen badly smoking factory chimneys throwing up clouds of smoke which drifted over the heart of the city like a pall.

Now why, he thought, should those few thoughtless managers be allowed to rob their fellow citizens of sunshine? They got little enough of it in all conscience. They were in his considered opinion greater criminals than the old-time garotters. Those murderers killed a few people, but these selfish sky polluters defiled the air for millions, and so lowered the vitality of those whose need was fresh air to a point at which bronchitis and pneumonia cut short their lives.

He knew oil was being used for central heating furnaces, but, having had the experience of a " smoke screen " on a friend's lawn, Sir Bruce was sticking to coke for his own central heating. He condemned flueless living and sleeping apartments and added that, in the matter of ventilation, no excuse of high cost of building should be accepted as a reason for such practice. Chimney ventilation was important on the grounds of general health. In conclusion, he pointed to the great value of correctly cooked food in the maintenance of the health of the community.

The need for local, as well as national, advertising was stressed by Sir Francis Goodenough, C.B.E., who said that " Eat more this " and " Drink more that " campaigns had come and gone, but the " Use more gas " campaign had been going on for a generation and was " still going strong." Advertising was twice blessed—it benefited the man who bought and the man who made. The consumer had profited in two ways—he had got appliances that were cheaper to run because they used less gas; and, as overheads had been reduced in proportion to turnover, he had got cheaper gas. That, he claimed, was largely due to advertising and should be a sufficient answer to those who said that the consumer paid for the advertising of the product he consumed.

One Company alone, by intensive advertising, had sold 1,000 gas refrigerators in three days. This national advertising, Sir Francis concluded, had made people gas-minded, but he repeated what he said in 1912—" Those undertakings that do the most local advertising will reap the greatest benefit from the national advertising. Each adds value to the other. The local paper, whether daily or weekly, has a special position in the affections of the citizens of that area. It is just as important to advertise locally as to shop locally."

Addressing the Women's Session, when the chair was taken by the Lady Mayoress (Miss E. Hodgson), the Association's Home Service Director, Mrs. Eileen Murphy, spoke of the choice of labour-saving appliances. When one bought a good cooker or a good water heater, one was making a gilt-edged investment in health and comfort for the whole family. The kitchen was the nerve centre of the house. For instance, a gas water heater in the kitchen might save bad tempers in the bathroom. On the subject of gas fires, Mrs. Murphy said that there would be far less influenza about if everybody had gas fires in their bedrooms. They were the healthiest fires one could get. Doctors used them and had them put into the wards of hospitals. In smoky towns, the speaker concluded, there was far more danger of children having rickets, and of grown-ups having diseases of the chest and throat.

Athletic and Social

Richmonds' (Radiation, Ltd.) Recreation and Social Club, Warrington.

The Bowling Section has had a very successful season, the principal event being the winning of the " Finlayson " Silver Challenge Cup. This is the premier competition in Warrington, the cup having been in existence for thirty-three years. Fifty-one teams were entered, and Richmonds' team succeeded in the final held on Aug. 31 by a record margin. In addition to holding the silver cup for twelve months, each member of the team will receive a gold watch. On the same day also the Horticultural Section of the Club held their first Annual Show. There were about 250 exhibits, and the judges congratulated the members on the high quality. Over 500 of the employees and their wives attended this pleasant function.

Messrs. Anderson Brothers' Group Outing.

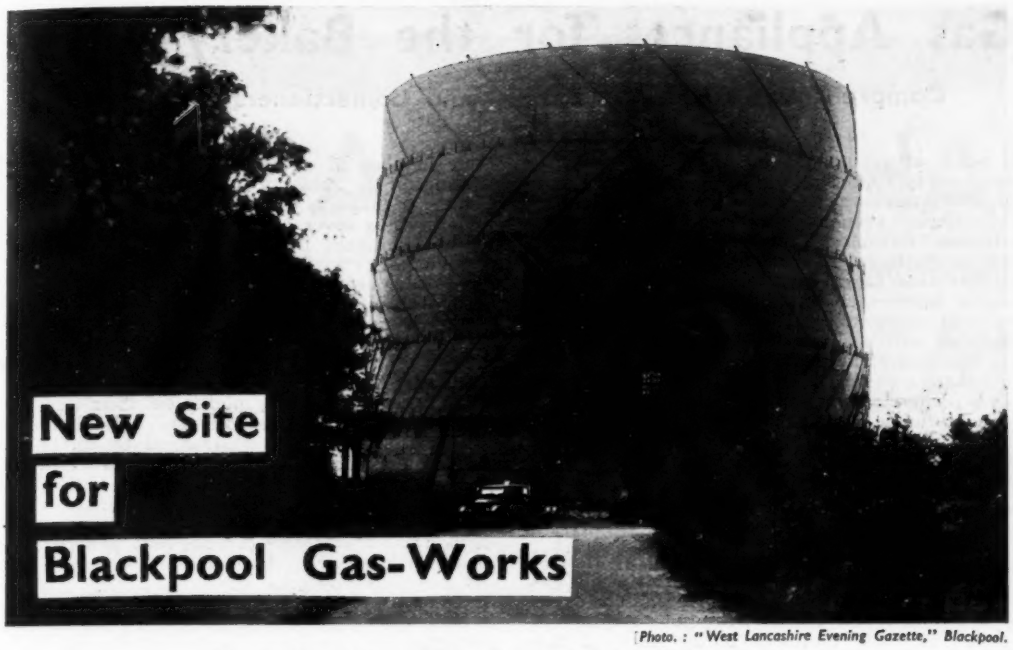
The annual outing of the employees of the Kilkenny Gas Works and the other kindred concerns in Ireland controlled by Messrs. Anderson Brothers took place this year to Liverpool. At least one member of the excursion party this year, Mr. M. Spittle, Manager of the Thurles Gas Company, Ltd., has a record of service with the firm extending well over half a century. A varied and interesting programme had been arranged by Capt. G. Anderson, Managing Director, who with Mr. L. W. Dalby, Manager of the Kilkenny concern, and Mrs. Dalby left nothing undone to ensure the pleasure of all. The Kilkenny contingent in charge of Mr. E. McEvoy journeyed by train to Dublin where the party was augmented by workers and friends from Queenstown, Fermoy, Thurles, Wicklow, and Warrenpoint. At an interesting function before the homeward journey was undertaken a hearty vote of thanks was passed to Capt. Anderson on the proposition of Mr. Dalby.

Manchester Gas Charges

Optional Two-Part Tariff System

The following optional two-part tariff will be available, under appropriate conditions, to consumers of gas for domestic, industrial, and commercial purposes through ordinary meters from and including the next reading of such meters after Sept. 30, 1935, and to consumers of gas for domestic purposes through automatic meters as from the next reading after the same date, within and without the boundaries of the City of Manchester, subject to approved application:

Class of Consumer.	Gas Consumed on One Premises per Quarter.		
	Within the City.	Without the City.	Discount.
Domestic supplies—			
Ordinary meters.	Service charge of 7s. 6d. per quarter		The price of gas is subject to a discount of 0·5d. per therm equivalent to 2½d. per 1,000 cu.ft. for payment within 28 days from delivery of account.
	Plus all gas consumed at 5·83d. per therm (2/2¾d. per 1,000 cu ft.)	*Plus* all gas consumed at 6·50d. per therm (2/5¼d. per 1,000 cu.ft.)	
Automatic meters	Service charge of 6s. 6d. per quarter (payable in advance on application)		Net
	Plus all gas consumed at 6d per therm (2/3d. per 1,000 cu.ft.—*i.e.*, 37 cu.ft. for 1d.)	*Plus* all gas consumed at 6·67d. per therm (2/6d per 1,000 cu.ft.—*i.e.*, 33 cu.ft. for 1d.)	
Industrial and commercial supplies.	Service charges: First 67·5 therms (15,000 cu ft.), 7s. 6d. per quarter. Above 67·5 therms (15,000 cu.ft.), 1·33d. per therm (6d. per 1,000 cu.ft.)		Discount as for domestic supplies (ordinary meters)
	Plus all gas consumed at 5·83d. per therm (2/2¾d. per 1,000 cu.ft.)	*Plus* all gas consumed at 6·50d. per therm (2/5¼d. per 1,000 cu ft.)	



New Site for Blackpool Gas-Works

[Photo. : "West Lancashire Evening Gazette," Blackpool.

The Blackpool Corporation Gas Undertaking have recently completed the first stage of the removal of the Gas-Works to a new site which is situated three miles from the existing works on the outskirts of the town.

The new site of 100 acres is bounded by the railway and roadways. The subsoil consists of clay, which is very suitable for inexpensive foundation work, and recourse to piling will be unnecessary. The work recently completed consists of a 30-in. diameter cast-iron trunk main, interconnecting the existing works with the new site, the main being connected to a new 3 million cu.ft. spiral-guided gasholder in steel tank erected on the new site. Boosting plant incorporating two Keith-Blackman boosters, each capable of dealing with 1 million cu.ft. of gas per hour, has been erected on the existing works to boost the gas to the new holder. The 30-in. main has been so arranged to serve six districts with gas, by means of Reynolds governors, interconnected to existing low-pressure mains for the purpose of increasing pressures during peak loads. The governors are automatically clock controlled giving the pressures at predetermined times and have been so arranged to feed the district mains when the boosting plant is in action, and also when the 30-in. main is feeding direct from the new gasholder on to the district mains.

The various costs are as follows:

Total Cost of the Scheme.

New gas-works site	£13,300
Gasholder—4-lift spiral-guided holder in steel tank, 3,000,000 cu.ft. capacity (R. & J. Dempster, Ltd.)	33,997
Excavation and foundations (R. & J. Dempster, Ltd)	2,500
Two boosters (Keith-Blackman), 1,000,000 cu.ft. per hour, 35 in. pressure	1,735
Booster house and connections (direct labour)	1,260
4,604 yds. 30-in. cast iron mains (Stanton) Special Class "B" specification (laid by direct labour)	11,834
Excavating, laying mains, and temporary reinstatement of trenches (tested to 20 lbs. sq.ft.)	6,996
Completed reinstatement of all trench work	1,949
Governors complete, pits, and connections	696
Total cost	£74,267

The total gas sold during the year ended March 31, 1935, was 1,298 million cu.ft. The number of consumers totalled 37,643—or an increase during the year of 2,277 new consumers. The net capital indebtedness of the Undertaking now stands at £276,831, which is equivalent to £216 per million cu.ft. of gas sold.

The maximum price of gas to ordinary consumers is 2s. 7d. per 1,000 cu.ft. less 5% discount, with a sliding scale to 1s. 6d. per 1,000 cu.ft. The maximum price of gas to slot consumers is 2s. 9d. per 1,000 cu.ft and for street lighting 2s. per 1,000 cu.ft.

Inauguration of Calor Gas Service

Representatives of the Industry Present at Leeds Ceremony

The Calor Gas Service for the North of England was inaugurated at a luncheon held at the Great Northern Hotel, Leeds, on Sept. 6. Among those present were the Lord Mayor of Leeds (Mr. W. Hemingway), the Lady Mayoress, the Mayor of Halifax (Mrs. Miriam Lightowler, a prominent member of the Halifax Women's Gas Development Association), Sir Alexander and Lady Seton, Mr. E. J. Fottrell, Mrs. Eileen Murphy, and many well-known gas managers.

The Loyal toast was given by Mr. H. Saville, who was responsible for the arrangements. No speeches were made at the luncheon, but afterwards the guests were given an impressive demonstration of appliances working on Calor gas. The Lord Mayor of Leeds, in opening the demonstration, said that he was interested in every new application of British coal. Calor gas was made in this country from British coal, and it could do the same work as coal gas in outlying districts where coal gas was not available.

Mr. C. S. Shapley and Mr. H. E. Bloor also spoke. Subsequently Mr. Pickering, the Calor-Gas Engineer, was besieged with enquiries from gas managers who contemplated the distribution of Calor gas in rural districts. Incidentally, Mr. Pickering mentioned that the companies in the South-Eastern Gas Corporation were interested in the new venture.

It was interesting to meet at the demonstration the first person to use Calor gas in this country. She is a keen yachtswoman, and had jumped at the chance of having gas cookery at sea. She told the "JOURNAL" representative that the cost of cooking by Calor gas for a family of four and a handy man came to £1 a quarter. She now plans to install a water-heater and refrigerator in her floating home.

There could be no doubt of the interest shown by gas managers in this new enterprise. Several guests wanted to take a cylinder home with them in their cars, and large supplies were booked for Wales.

There was the usual range of gas appliances—cookers, fires, water-heaters, lighting burners, gas kettles, boiling rings, &c. The portability of Calor gas was well demonstrated. All these appliances were shown in the drawing-room of the hotel, without a hitch of any sort. A number of guests commented on the strength and beauty of the lighting.

Gas Appliances for the Bakery Trade

Comprehensive Display at Bakers' and Confectioners' Exhibition

That the value of gas for baking and allied purposes is being more readily appreciated in all quarters is evident from the increased number of gas appliances displayed by a variety of different oven manufacturers at the Bakers' and Confectioners' Exhibition, which is open during the present week at the Royal Agricultural Hall, London.

As usual, the Gas Light and Coke Company have a striking display which includes a representative selection of gas ovens and accessories by various well-known oven builders, together with some developments of their own, such as side flue conversion sets, in which the main gas tap is interlocked with the damper, and the "G.L.C." doughnut fryer, whose salient points have previously been noted in these columns. In an adjoining hall the Company have secured a large space for demonstrations, and, in co-operation with the Ellerstyle Engineering Company, Ltd., have staged an up-to-date all-gas bakery in which various demonstrations are carried on by expert bakers. These are attracting a considerable amount of interest among visitors to the Exhibition.

As a whole the Gas Light and Coke Company's stand may be described as indicating typical ways in which gas can be of service to the baker and confectioner. The ovens include the two main types—namely, the hot-air type and the steam-tube type, while the model of the Kent side-flue oven which has been converted to gas firing shows how easily ovens already using solid fuel can be adapted to this more reliable and up-to-date form of heating. In addition, there is an example of Ellerstyle's three-deck "Thermtrap" pastry oven, while the "Thermspray" boiler by the same firm for injecting wet steam into the ovens are included among the appliances displayed. Oven fronts representative of the products of Cox & Son, Dumbrill Plant and Engineering Company, in addition to the two other firms whose names we have already mentioned, complete the larger apparatus shown; but a storage gas water heater and gas-operated refrigerator indicate that gas can be of wider service in the bakery of to-day than in the actual baking work alone.

The four firms we have mentioned have, of course, stands of their own, where their apparatus is shown in greater detail; and in these cases there is little to add to the description of their various ovens which we gave in these columns last April in connection with the London Baking Trade Exhibition at the New Royal Horticultural Hall.

We may mention, however, that very high efficiency is claimed for the Cox "Super Heat Trap" gas oven, which is built in one, two, three, or four deck sizes, and is subject to very accurate temperature control. After the gas has been turned down, the oven can be worked for several hours on stored heat, and even after standing by for 24 hours the lost heat can be quickly regained. This oven is designed and constructed on thoroughly scientific lines, a steady heat being so distributed as to ensure perfect baking. The system is based on the laws of gravitation—hot air being lighter rises to the top while the cooler air falls. The act of driving on fresh heat to take the place of that being used expels the chilled products, so heating the oven to an even temperature throughout.

The Dumbrill "Supergas" steam tube oven is the result of several years' continuous experiment carried out by the firm's research engineers in close co-operation with large gas undertakings. This oven incorporates independent heat control for each deck, and when necessary only one deck need be fired. "Smalls" can be baked in one deck and bread in the other simultaneously.

A wide range of baking equipment by Ellerstyle is shown not only by the Gas Light and Coke Company but also on the firm's own stand. The "Thermtrap" oven is shown fitted with the "Thermspray" boiler to provide steam for Vienna and quality bread, and also with a gas light box, switch controlled, for illuminating the oven interior. This oven is neat, compact, and efficient, while the "Thermspray" incorporates an automatic regulator which controls the gas when steaming.

The "Thermtrap Junior" gas-fired oven is another interesting apparatus by the same firm. This has steam-tight individual baking chambers, and no products of combustion come in contact with the articles being baked. Each deck is externally heated on top and bottom, and the special construction assures that the hot gases pass to the front of the oven before reaching the back, giving uniformity of heating. The lower deck is provided with a tiled sole, and is suitable for baking bread with or without tins.

A number of ovens are being shown by Messrs. T. Errington & Sons, of Portsmouth, most interesting of which, perhaps, is their new "Southsea" gas oven which incorporates several interesting features. The burner is of the luminous flame type, and the hot products heat the chambers without passing over the food being baked. The makers claim a cost with this oven of 1s. 9d. per nine-hour working day at full load with gas at 7d. per therm.

Another gas oven by the same firm has bunsen burners in connection with which is fitted a patent non-back-fire gas cock and air regulator. Messrs. Errington also manufacture a number of models for coke firing, and these too have some interesting points in their construction, including a hot water system specially designed for hard water districts. This is arranged by an indirect system of heating whereby the water heated in the copper coil does not mix or come into contact with the hot water which is drawn off. This oven is also fitted with a prover, steam for which is provided by an ingenious method. The firm also manufacture a doughnut pan, together with a neat chromium-plated coffee urn for restaurant purposes, both operated by gas.

The Four Oaks Spraying Machine Company are showing a complete range of their spraying, lime-washing, and disinfecting machines, for spraying dough and for lime-washing bakehouses and other buildings. Such machines are also useful for washing down motor vehicles, traps, &c.

Messrs. Thomas Collins & Co., Ltd., of Bristol, have a very comprehensive display which includes both gas and coke fired ovens. Their "Gas-de-Luxe" circulating hot-air type oven is constructed on advanced principles, incorporating thermostatic control and a heat accumulator system whereby at the conclusion of the heavy baking the gas may be turned off and baking continued for a considerable period with the stored up heat. Such systems enable this type of oven to be used in districts where the cost of gas might otherwise render the fuel prohibitive. This firm also make several designs of coke-fired ovens, chief of which is their "Super Tridex Heatstor" three-deck brick-cased steam-pipe peel oven. This oven can be supplied with the top deck separately heated or with one small concentrated furnace to heat all chambers. The fire-box is just the length of a man's arm, which makes for convenience of operation, while there is also incorporated a special draught control.

In addition to the conversion set on the Gas Light and Coke Company's stand, Messrs. Kent & Co., Ltd., are showing on their own stand examples of their "Globe" ovens in various types and sizes. These include solid brick-built steam tube ovens, portable steam tube ovens, and a working gas-fired oven.

The products of Messrs. Thomas & Bishop, Ltd., are by now well-known in the Gas Industry, and a representative selection of these are exhibited on their stand, including "Flexo" belt treatment in paste and liquid form, jointing paste, lubricating grease, tinning compound, refractory cements, and their "Permac" metal-to-metal jointing material.

A number of other firms are showing gas equipment to a lesser degree, and altogether this year's Exhibition has probably provided a better showing for gas than any of its predecessors, and indicates more forcibly than ever the great service gas is rendering to the bakery trade—stimulated, no doubt, by the useful discounts many gas undertakings are offering for this valuable load.

Properties and Treatment of Metals

Chelsea Polytechnic Courses

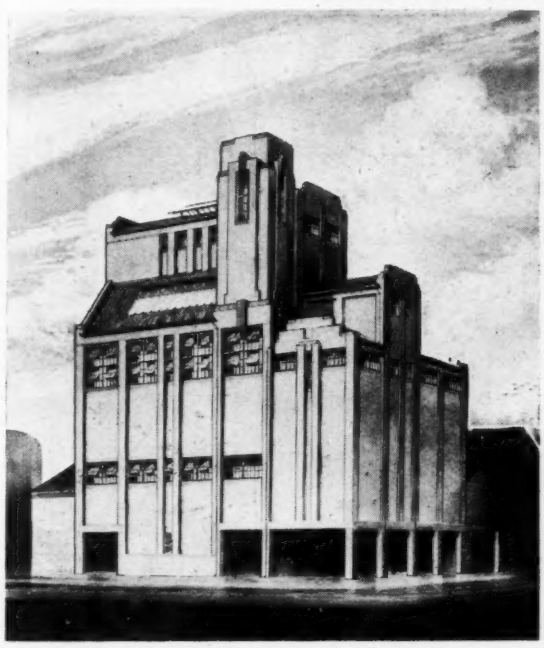
We are indebted to the Head of the School of Metallurgy of the Chelsea Polytechnic for particulars of three classes on the properties, uses, and treatment of metals specially arranged for those employed in the various branches of industry, either working, machinery, or otherwise dealing with metallic articles.

With the extending use of gas for industrial purposes, particularly that of melting and heat treatment of metals, these courses should be of interest to the Industry, and class (c), which is a two-year course in engineering metallurgy, has been recognized by The Institution of Gas Engineers.

WOODALL-DUCKHAM

CONTINUOUS & INTERMITTENT

VERTICALS



Design Drawing for the new Installation at Loughborough

INSTALLATIONS IN COURSE OF CONSTRUCTION

	Capacity in Tons per Day
ALGIERS (North Africa)	213
BARI (Italy)	24
BIRMINGHAM (9th Installation; Windsor Street)	591
BRECON	10
CHESTER	132
ELGIN (2nd Installation)	12
EPPING	25
ILKESTON	65
LIVERPOOL (3rd Installation)	153
LOUGHBOROUGH	42
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STOURBRIDGE (3rd Installation)	63
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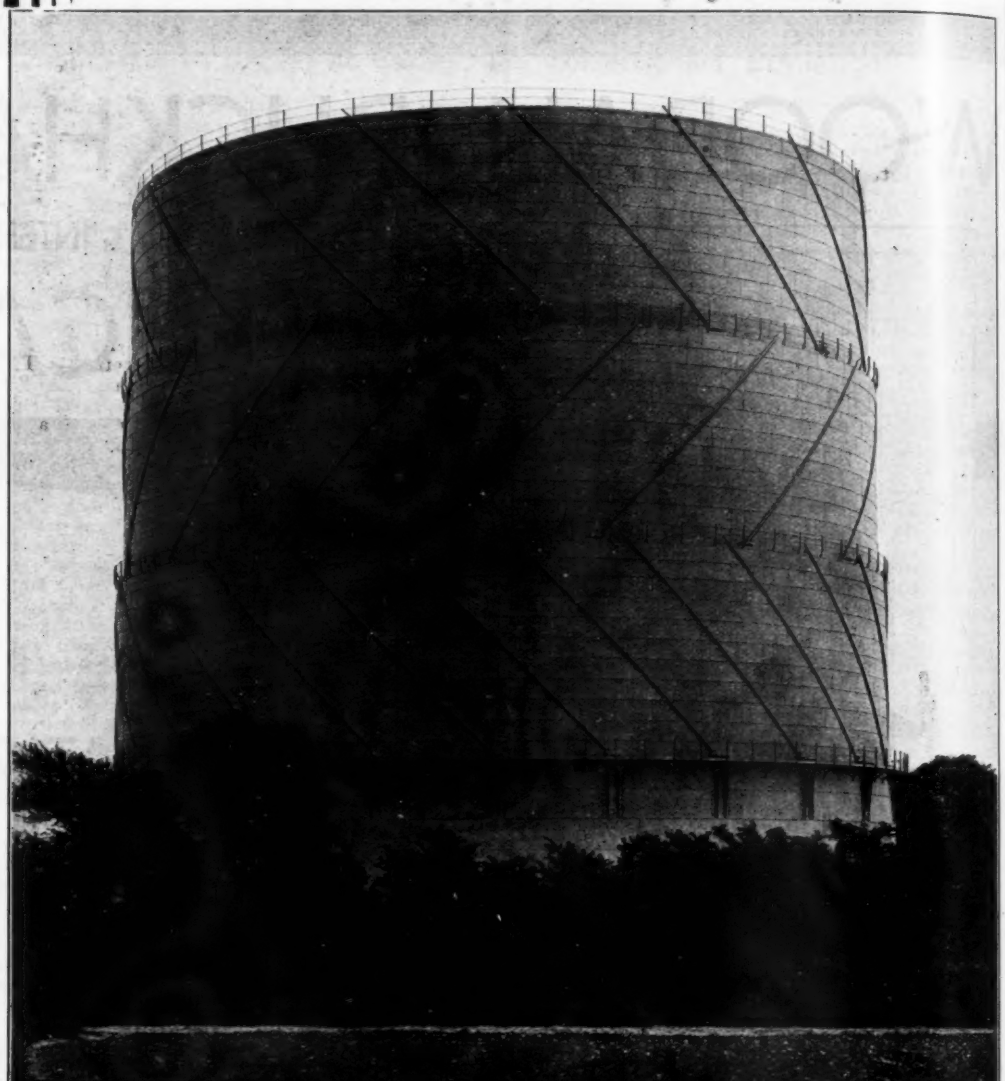

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Benzole Recovery

by

G. W. PAGE,

Superintendent, Montreal Coke and Manufacturing Company,
Montreal, Quebec.

A Paper read before the 28th Annual Convention of the Canadian Gas Association at Quebec last June.

Most of the gas plants, during the Great War, scrubbed their gas for light oil primarily to obtain the benzole and toluole for the manufacture of explosives, but nearly all discontinued these operations at the termination of the war. During the past two years, however, due to increased commercial demand, many gas plants have restarted their benzole recovery plants.

General practice for the recovery of aromatic hydrocarbons in their combined crude state, commonly known as light oil, is carried out with the use of absorbent oils usually called straw oil or wash oil. Analysis of the wash oil used at the Montreal Coke and Manufacturing Company's plant is given in Table No. 1.

TABLE No. 1.

F.D.	5%.	10%.	20%.	30%.	40%.	50%.	60%.	70%.	80%.	90%.	Dry.
294° C.	310	313	317	320	323	326	329	332	337	343	351

Specific gravity—0·867. Emulsification—100% in 9½ min. Olefiness—23%. Cold test—Soupy at 30° F.

TABLE No. 2.

Sample.	F.D.	10%.	95° C.	100°.	120°.	150°.	180°.	200°.	Dry.
Sec. L. oil	132° C.	297° C	..	..	1·5%	3·0%	4·0%	4·5%	..
Inter. L. oil	98·3	159	..	..	2·8	8·4	19·0	36·0	296° C.
Prim. L. oil	76·4	95·7	57·0%	67·8	82·9	91·0	95·1	..	185

The gas leaves the final cooler at about 25° C. and passes through three benzole scrubbers in series, flowing counter-current to the wash oil which absorbs the light oil in the gas.

From the scrubbers the benzolized oil is pumped through the vapour-to-oil heat exchanger, being preheated by the light oil and steam vapour from the still to 100° C., thence to the final heater where the oil is heated to 120° C. by indirect steam, before entering at the top of the wash oil still. Exhaust steam furnished by the wash oil circulating pumps is admitted at the bottom of the still, stripping in counter-current the benzolized wash oil of its light oil. Debenzolized oil leaving the bottom of the still at 118° C. flows to the hot oil decanter tank, where any exhaust steam condensate which has been carried from the still will drop out. The oil overflows to the hot drain tank and is then pumped through the cooling coils (reducing the temperature to about 28° C.) into the cold oil decanter tank, and overflows to the circulating tank; from here it is again pumped over the scrubbers, thus completing the cycle.

Light oil and steam vapour pass from the still through the vapour-to-oil heat exchanger outside of tubes. The cold benzolized oil inside of the tubes serves to condense the water and heavier oil vapours. This condensate mixes with any wash oil which may have been carried over mechanically and is passed through a separator, decanting the water, and is then returned to the benzolized oil stream entering the vapour-to-oil heat exchanger. The distillation range of this condensate or secondary light oil will be found in Table No. 2.

From the vapour-to-oil heat exchanger the vapours pass through a reflux condenser. This apparatus facilitates the production of a high grade light oil, condensing the higher fractions such as naphthalene and heavy solvents, which otherwise would finally appear in the pure still residues, adding to the refining costs, since no distillate over 180° C. dry point can be used to meet motor fuel and xylol specifications. Condensate from the reflux condenser is called intermediate light oil and distils as shown in Table No. 2.

The remaining vapours leave the reflux condenser and enter the Sterling condenser or light oil cooler. The condensate flows to the primary light oil separator, where water and oil are separated, the light oil overflowing near the top to the light oil storage tank. This final product or primary light oil distills as shown in Table No. 2.

It will be noted that the apparatus and methods employed for the recovery of crude light oils at our plant do not differ greatly from those used in earlier practice during pre-war days, the exceptions being: A more efficient vapour-to-oil heat exchanger; the use of the oil-to-oil heat exchanger has been discontinued; the addition of a reflux condenser.

The vapour-to-oil heat exchanger consists of a bubble tray and three tube nest sections. The vapours leaving the still enter the bubble tray at 120° C. and then filter through the three tube nests. The incoming benzolized oil enters the top of the exchanger at 25° C., making sixteen passes through the tubes of each section or a total of forty-eight passes, finally leaving the bottom section to enter the final heater at 100° C.

In older plants the oil-to-oil heat exchanger is standard apparatus, but in plants of recent years this has been omitted. Where formerly benzolized oil entering the still was heated to 140° C., 120° C. is now sufficient, as enough exhaust steam is available for the circulating pumps to efficiently strip the benzolized oil in the still. It means less apparatus is required, reducing maintenance cost; heat economy is increased by use of exhaust steam and prevents the "breaking-down" of the wash oil due to lower temperatures.

The reflux condenser enables the production of light oil of any desired point, which may be required to more readily meet the specifications of pure products, thus reducing washing costs by elimination of heavier fractions in the light oil. This apparatus consists of a cylindrical tank filled with coke. Vapours leaving the vapour-to-oil heat exchanger enter the bottom and pass through the coke bed, the heavier vapours being condensed by primary light oil which is pumped into the condenser at the top through four Spraco nozzles.

Washing Crude Light Oil.

The method for washing crude light oil at our plant is known as the Ufer Process, whereby, in actual operation, 91% of the acid used is recovered, and in most cases no sludge is produced for disposal. Sludge formed by agitation with strong acid is dissolved in the light oil by diluting the strong acid with a certain amount of water during the agitating period, and finally reappears as resin in the pure still residue.

To wash a 4,500-gall. charge of light oil in a standard type Koppers lead lined agitator, operation is as follows:

Settling fresh charge	20 min.
Drain off water (if any)	5 ,,
Start agitator and add 50 galls. acid slowly	10 ,,
Watch temperature rise; if it exceeds 38° C. allow time for cooling	10 ,,
Add another 50 galls. acid slowly	10 ,,
If no further rise in temperature is shown add 150 galls. acid	15 ,,
Agitate sufficient length of time to arrive at colour test desired (in our case Barrett No. 10)	3 hr. 30 ,,
Add 350 imp. galls. water rapidly and continue agitation for	30 ,,
Settling diluted acid	30 ,,
Drain off diluted acid	30 ,,
Water wash no agitation—settling and draining	30 ,,
Add 250 galls. caustic soda (20% NaOH) and agitate	3 hr. 30 ,,
Settling caustic	1 hr.
Drain off caustic	30 ,,

The most essential points are the use of the proper strength of acid, thorough agitation of the light oil and acid within the temperature limits of 38° to 45° C. By means of four lead coils suspended inside the agitator the temperature of the light oil during the washing period can easily be held below 40° C. Removal of unsaturates and re-solution of the sludge depend upon having brought about the proper degree of polymerization, controlled by the density of acid and temperature of reaction.

The proper density of acid must be determined by a few trials with each light oil, which in our case is 64·5° Baume. 66° Baume acid is diluted with water in a tank separate from the storage tank. This diluting tank is equipped with an air connection for agitation during water additions to ensure proper mixing. Following is Table No. 3 for 66° Baume acid dilution, volume at 60° F.:

TABLE No. 3.

66 H_2SO_4. Parts by Volume.	H_2O. Parts by Volume	Baume. Mixture 60° F.
91·5	8·5	65
86·2	13·8	64
82·1	17·9	63
78·8	21·2	62
75·8	24·2	61
73·1	26·9	60

The amount of acid used in washing a charge of light oil is really of no importance from the standpoint of acid consumption, since all the recovered acid is used for sulphate production and should be charged against the By-Product Department. On this basis our figures, in terms of 66° Baume Acid, average:

	Lb. Galls. L.O.
Acid for washing	0·743
Acid recovered (used for sulphate production)	0·677
Acid consumed	0·066

Use of Ufer acid in the saturators has no effect on the colour of the sulphate produced. It has, however, a tendency to cause smaller crystals. We noticed this at a time when 50% of the total acid used in the saturators was Ufer acid.

Distillation of Washed Products.

The equipment for the distillation of washed light oil is vastly improved over the type of apparatus used ten to fifteen years ago, presenting a more compact and neater lay-out and consequently reducing the cost of a plant of this design.

The rectifying column is removed from the still kettle and occupies its own foundation adjacent to that of the still kettle outside of the building.

The still tank is 10 ft. in diameter by 18 ft. long and has a capacity of 8,500 Imperial galls. It is equipped with two tube nests, having a total heating surface of 680 sq.ft. The 10-in. vapour outlet connects the still tank to the rectifying column.

The rectifying column is built of $\frac{3}{8}$ in. and $\frac{5}{16}$ in. steel plate and is 5 ft. in diameter and about 60 ft. high. It contains 24 bubble cap trays welded in place, consisting of $\frac{1}{16}$ in. steel plate with forty 3-in. pipe vapour passes with a cast-iron bubble cap on each. A manhole is provided in the shell above each tray. The overflow pipes consist of two 4-in. drop pipes in each tray.

There is no dephlegmator mounted on top of the column. This apparatus is replaced by a reflux system consisting of a weir box for proportioning the ratio of reflux to the product make. The weir box is provided with adjustable weirs, so arranged that the ratio between the product and the reflux can be set as required, the product flowing to the receiver and the reflux to a chamber equipped with a liquid level regulator for operating a by-pass valve between the discharge and suction of the reflux pump to keep the pump in step with the reflux flowing from the weir box. To this chamber the reflux pump, of 2,000 galls. per hour capacity, is connected and delivers the reflux volume through a 3-in. line to the top tray of the column. This has the same effect as the reflux condenser in the light oil plant, condensing the heavier vapours. This condensate returns to the still tank through a 4-in. line from the bottom of the column.

Vapour leaving the top of the fractionating column passes through a 10-in. line to the vapour neutralizer, where it is treated with caustic soda solution. This apparatus consists of a cast-iron shell 5 ft. in diameter by about 8 ft. high, with two trays and a bottom inlet section. Each tray has thirty-six 3-in. bubble caps. Spent caustic solution (7% NaOH) recovered from the agitator after treating acid washed light oil is drained to a caustic circulating tank and pumped from there to the two trays of the vapour neutralizer. This method of hot vapour bubbling through the soda solution assures a non-corrosive product.

A soda separator is provided for separating the oil products from the soda solution in the condensate leaving the vapour neutralizer. This separator is 18 in. in diameter by 5 ft. high, of cast-iron construction, and provided with two sight flows, one for oil condensate and the other for soda solution, which from this point returns to the soda circulating tank. The oil condensate is piped to the suction of the reflux pump.

After leaving the vapour neutralizer the vapour passes through a 10-in. line to the cooler or condenser. This cooler is of the drip type with fixed tube sheets and the shell built of steel plate. It contains two tube nests having an O.D. tube surface of 680 sq.ft. The tubes are 1 in. O.D.

Condensate flows from the cooler through a 3-in. line to the separator, where water is decanted from the oil products which flow from the separator to the weir box of the reflux system. From here the properly proportioned product enters the receiver and then flows to its allotted tank.

Pure Still Operation.

The still is charged with 8,500 galls. of washed light oil. Sufficient steam is applied to the coils to bring over a flow of distillate within two hours. The weir box of the reflux system is set to reflux the entire volume of distillate at the start of the run. This is done merely to free the entire vapour system of heavy solvents or naphthalene, which may not have properly drained after completion of the previous run. At the same time the object is to bring over a stream of distillate sufficiently large to facilitate the proper proportioning of the flow.

For motor benzole when a rate of flow of 800 to 1,200 galls. is reached, the weir box is set at a ratio of two parts to production and one part to the reflux chamber until such time as the distillation test shows the product is leaving the benzole range. The ratio between the reflux and the product is then changed, sending three parts to reflux and one part to production. This method of operating the weir box keeps the intermediate fractions to a minimum. When the dry point of the product reaches 93° C. the valves to the motor benzole tanks are closed and the product is run to the crude toluole tank. The weir box is again set as during the benzole fraction until a distillation test shows a dry point of 118° C., when it is reset as in benzole-toluole intermediate. The product continues to run to the crude toluole tank until the test shows a first drop of 120° C. Refluxing is then discontinued, the weir box being set to throw the entire flow to production, which from this time on flows to the crude solvent tank. When a dry point of 185° C. is attained the still is shut down.

Fractions dumped to the crude toluole and crude solvent tanks are rewashed to meet the colour specifications of pure products.

Operation of the reflux system during pure toluole and pure solvent fractions is similar to a washed light oil run, except that, until the desired pure product is reached, the weir box is sometimes set at five parts to reflux and two to production and never less than three to one. Throughout the pure product distillation range the reflux ratio is maintained at one to one.

Deodorizing the Product.

Due to increasing commercial demand for pure light oil fractions, mainly from the paint industry, the final product, either pure benzole, pure toluole, or pure solvent, must meet very exacting specifications. Frequently a pure product may meet all the requirements except the odour specification.

Extensive research work has been done to find a treating agent for malodorous products. The most popular of these in modern practice to-day is "Merclor," a sodium hypochlorite solution containing 12% available chlorine by volume.

"Merclor" and the product to be deodorized are pumped through a mixing chamber to a separator equipped with two sight overflows arranged at different levels, the higher one being piped to the pure product tank, while through the lower one the treating agent returns to its circulating tank. Circulation is continued until the product is entirely free of what we call "a gas-house odour."

"Merclor" is very corrosive and all apparatus used for the treating process is immediately washed out with water after a deodorizing run has been made.

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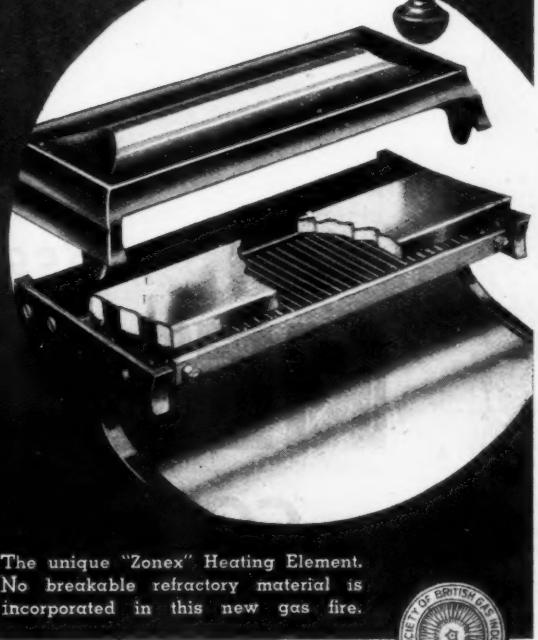

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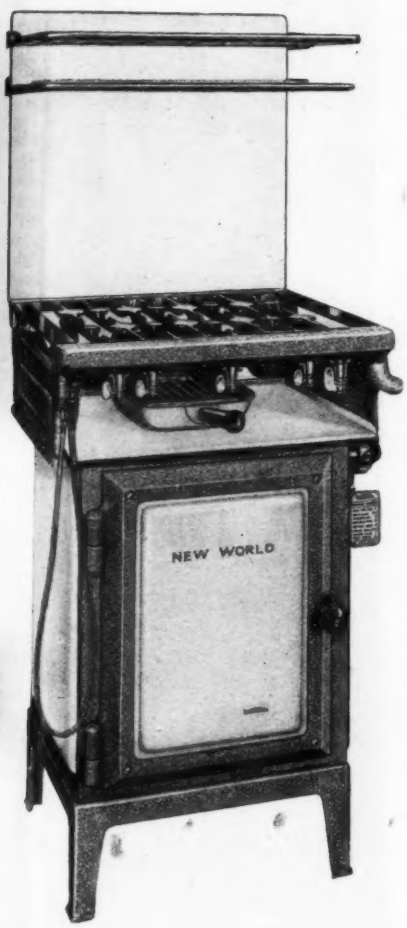

THE wider the scope of advertising—the more enlightened its application—the greater becomes the power of personal recommendation to make sales. Right from 1923, when the 'New World' Cooker was introduced with the 'Regulo' as the pioneer of automatic heat control, one primary object has possessed the manufacturers. *That object is to maintain the highest possible standard of perfection in workmanship* throughout every detail of construction. No works test has been considered too costly to ensure this maintenance of the goodwill both of Gas Undertaking and Public. For this reason, the 'Regulo' stands alone to-day, as it did literally in 1923, as the most perfect example of consistently accurate automatic oven-heat control.

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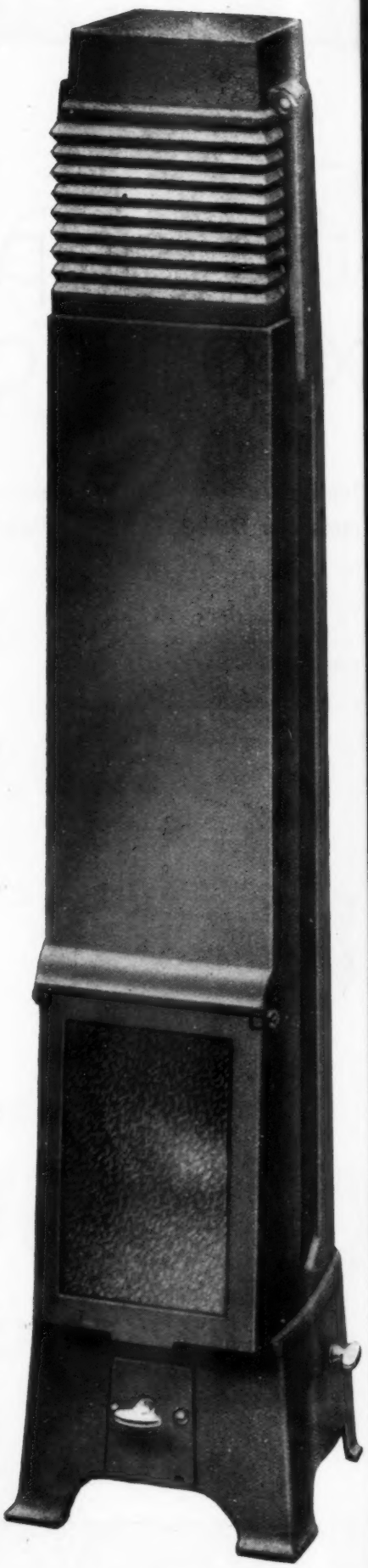

CANNON

AN INSTITUTION REPORT ON

Protective Coatings for Underground Pipes

by
A. B. DENSHAM, M.A.,
and
F. C. SMITH,
Assoc.M.Inst.Gas E.

From a Report (Publication No. 115) issued by The Institution of Gas Engineers.

INTRODUCTION.

The external corrosion of underground service pipes and steel mains is a serious problem for the Gas Industry. This corrosion is usually classified under two headings:—

(1) Soil corrosion, due to the corrosive action of soil water.
(2) Electrolytic corrosion due to stray electric currents.

In country districts it is probably enough to protect against soil corrosion, but in towns any satisfactory means of protection must be effective against both types of corrosion. This report deals with urban conditions on the area of the Gas Light and Coke Company.

It has been stated that wrought iron corrodes less than steel, but it cannot be denied that both metals do corrode rapidly under unfavourable conditions, so that both require protection underground. It is important to know whether wrought iron is much more resistant to corrosion than steel, for unless the advantage is considerable it would appear more reasonable to use the cheaper steel with an adequate protective coating.

A considerable amount of money has been wasted in the past on more or less useless coatings. It is important, not only to decide on the best form of protection, but also to be able to specify it so that it can be bought and tested to a rigid specification. This entails a consideration of the characteristics of an ideal coating, and the simplest and quickest methods of testing these characteristics.

Any conclusions as to the most suitable coatings and methods of test arrived at by laboratory methods must be tested by field experiments under controlled conditions.

The authors' thanks are due to the Governor and Directors of the Gas Light and Coke Company for permission to publish this report. Thanks are also due to colleagues at Watson House, especially to Mr. C. A. Masterman, Chief Technical Officer for a number of suggestions, to Mr. G. W. C. Wood who supervised the laying and coating of the pipes, and to Mr. R. F. Hayman and Mr. F. C. Moody who carried out many of the measurements and analyses. Acknowledgments are due also to Mr. H. J. Escreet, Distributing Engineer, the Gas Light and Coke Company, and various members of his department, as well as to several firms of manufacturers for their co-operation.

METHODS OF TESTING COATINGS.

The only absolute method of testing a coating is the practical one, *i.e.*, to apply the coating to a pipe, and bury it underground for a long period.[55] But for practical purposes it is necessary to have an accelerated test.

Experience and theory are in agreement that the most successful protection for ferrous pipes underground is a coating that keeps water permanently away from the pipe,[50] so that it must not only be waterproof, but must itself be resistant to corrosion or mechanical damage.

It is true that Beck in particular has advocated colloidal[1, 2, 3] * protective agents, which do not entirely keep away water but claim to inhibit corrosion. But while colloids and large organic molecules undoubtedly do decrease corrosion,[4, 5, 6, 7, 8, 17, 18] yet even under the most favourable laboratory conditions protection is incomplete, while the most active protective colloids are organic in character, such as would be rapidly decomposed by soil bacteria.

Ignoring then the claims of colloidal protection the following desirable characteristics must be considered in the development of accelerated tests for pipe coatings:—

(*a*) Resistance to water penetration.
(*b*) Resistance to decay.
(*c*) Resistance to mechanical damage.

(*a*) Resistance to Water Penetration.

When the pipe coating material can be obtained in the form of a film or supported on a porous diaphragm, the resistance to diffusion of a dissolved electrolyte affords a convenient method of measuring resistance to water penetration. If distilled water is placed on one side of the film, the diffusion through of a dissolved electrolyte from the other side can be followed by an increase in the conductivity of the distilled water.

Coatings already applied to pipes can be investigated by measuring the electrical resistance between the pipe and water in contact with the coating. Since most coatings are made of insulating materials, any penetration of water into the coating will bring about a fall in electrical resistance. The method is not of course applicable to metallic or other conducting coatings.

The measurement of the electrical resistance of a coating offers certain difficulties; these are discussed in Appendix 1, and reasons are given there for using a low frequency A.C. Megger.

(*b*) Resistance to Decay.

In England the only components of pipe coatings liable to decay are fabrics used as reinforcements.* There is no accelerated test for the rotting of fabrics (the use of higher temperatures to increase decay is unsound, since above 25° C. rapid attack by fungi sets in, whereas at lower temperatures decay is due to bacteria[11, 12]), but there is evidence to show that fabrics do not rot appreciably if well impregnated with pitch or bitumen. It has recently been suggested to impregnate fabrics with creosote.

(*c*) Resistance to Mechanical Damage.

(1) The resistance to a blow can be investigated by striking the coating with a standard blunt chisel falling down a tube from a given height. Remeasurement of the electrical resistance shows whether the coating has been cracked or pierced. This test can be applied if required at maximum summer or minimum winter temperatures.

(2) It is difficult to measure quantitatively the adhesion of a coating to a pipe. Some tests were made with a die slightly larger than the pipe; the weight was measured which was required to force a given length of pipe through the die, thus stripping off the coating. The method was unsatisfactory.

Scott Ewing[20] has described a method of investigating the distortion and removal of a coating by soil action.

In the absence of a convenient test for adhesion it is advisable, in the case of the ordinary pitch or bitumen hessian coating, to ensure that a continuous film of pitch or bitumen remains on the pipe when the outer coating of fabric is stripped off.

(3) Distortion may occur when pipes are packed together in hot weather. The coatings may stick together so as to be partially stripped off when the pipes are separated. A simple test consists in placing two stripped off squares of coating together under a weight at a maximum summer temperature of 120° F.[15] for a definite time, and seeing whether they stick together.

(4) Some more elaborate tests dealing with the effect of vibration and change of temperature are described by Beck.[3]

The details of these accelerated tests are described in Appendix 2.

* See Bibliography, Appendix 4.

* In tropical Africa white ants have been known to devour all the bitumen from a coated pipe.[14]

TYPES OF COATING.

It is not intended to give a complete account of all possible types of coating. Table 1 gives a list of some of the coatings which have been tested under practical conditions and in the laboratory; the same coatings were used in the experiments described in Section VI.

TABLE 1.—*List of Coatings Investigated.*

(1) Galvanizing.
(2) Bituminous Paint—
  (*a*) Proprietary material "A"—applied over red lead.
  (*b*) " " "B"—covered with insulation tape.
(3) Portland Cement.
(4) Troughing with hot Pitch—
  Coating of joints on coated tubing with hot pitch in cardboard moulds.
  " " " " " " " metal "
(5) Pitch or Bitumen coatings reinforced with fabric.
(6) Bitumen Asbestos Sheathing.
(7) Adhesive Bandages—
  (*a*) Consisting of cotton fabric filled with grease—proprietary material "C."
  (*b*) Thin bandage consisting mainly of hydrocarbon material—proprietary material "D."

(1) *Galvanizing.*

Very satisfactory results have been obtained with galvanized coatings in certain soils, [21, 22] but they can only give a very poor protection against electrolysis.

(2) *Bituminous Paints.* "A" and "B."

Bituminous paints are usually porous[23] and are rapidly removed by soil action.[24] They give hardly any protection underground against corrosion.

Protection of the paint with insulation tape is not effective, as the tape rots underground.[25]

(3) *Portland Cement.*

Cement troughing is a good protection against soil corrosion, except when there is a high concentration of magnesium salts in the water,[25] but, owing to its porous nature, it is of little use against electrolytic corrosion.

(4) *Troughing with Hot Pitch.*

Pitch troughing has shown itself a good protection under a variety of conditions. There is a sample of pipe at Watson House which has been underground for over 60 years, and is as good as new.

The technique of troughing requires a little care. The pitch used must not be too soft or too brittle. The wood used for the trough must be large enough to contain the pipe easily. Suitable supports must be used, so that the pipe does not rest on the wood and so prevent the pitch from flowing round underneath.

Metal and cardboard moulds are used to protect *in situ* and with hot pitch the joints of pipes which are coated for the rest of their length at the factory. Metal moulds are removed afterwards, which means that it is necessary to wait till the pitch has set, whereas cardboard moulds are left in the ground. On the other hand metal moulds ensure a more even coating of pitch round the joint. The pitch used is the same as that for troughing. In some cases bitumen impregnated hessian is used to reinforce the pitch.

See also Appendix 2.

(5) *Pitch or Bitumen Coatings reinforced with Fabric.*

Pitch or Bitumen Coating reinforced with Fabric is applied at the factory, and it is necessary to coat the joints separately *in situ* (see above). The coating consists essentially of a continuous layer of pitch or bitumen in contact with the pipe, which keeps out moisture. This layer is protected against mechanical damage by a spiral of hessian or felt impregnated with the pitch or bitumen.

There is conflicting evidence as to whether coal tar pitch or bitumen is the better for use in pipe coatings. Bitumen has a slight initial advantage as far as mechanical properties go—it remains plastic without melting or becoming brittle over a wider temperature range—but it is now possible to obtain a wide plastic range with pitch by adding coal dust,[26] coir dust,[23] or other fillers.

Pitch, on the other hand, has a better resistance to water penetration.[27, 58] The Report of the Dutch Corrosion Committee[28] is misleading in this connection, because asphalt is compared with crude coal tar instead of refined pitch. Some measurements were made at Watson House by the diffusion method using films about 0·1 mm. thick. The materials investigated were:—

Blown asphalt	Softening point*	85° C.	(B & R) Penetration*	5 at 25° C.
Coal tar pitch	"	" 77° C.	"	"	1 "
" " "	"	" 53° C	"	"	9 "

*See Appendix 2.

In no case was there any appreciable penetration either of N potassium chloride solution or of 10 per cent. hydrochloric acid after 500-1,000 hours, although resistance tests showed that the pitch retained its insulating properties rather better.

The accelerated test for resistance to water penetration was developed specially for this type of coating, and its introduction improved the quality of commercial coatings from a resistance of 200 ohms sq. ft. to a minimum of 10,000 ohms sq. ft.

The rotting of the fabrics used has been investigated by estimating the decrease in cellulose content[13] after immersion in filtered soil water at 23° C. for a long period.

TABLE 2.—*Rotting of Fabrics in Water at 23° C.*

Fabric.	Number of Samples.	Average Period of Rotting in Days.	Average Per Cent. Decrease in Cellulose Content.
1	2	3	4
Hessian	8	180	13
Hessian soaked in creosote	1	257	0
Hessian soaked in white spirit	1	149	9
Ordinary coir	2	234	26
Coir treated with ionized vegetable oils	2	239	7
Adhesive bandage "C"	1	202	75

The results are based on only a few samples, but they do suggest that it would be advantageous for all fabrics used in pipe coatings to be impregnated with creosote; but it is probably enough to insist that the fabrics should be thoroughly impregnated with the pitch or bitumen of the coating, so that no white fibres can be seen.

Adhesion to the pipe is improved by a very light priming coat of green oil[28] but this is not necessary provided the pipe is heated, or that the pitch or bitumen is applied hot enough to wet the pipe.

Mechanical damage is prevented by the layer of impregnated hessian or felt. Distortion by heat is prevented by rolling in sand and whitewash to give a hard white exterior.

See also Appendix 2.

(6) *Bitumen Asbestos Sheathing.*

Bitumen asbestos sheathing is similar in characteristics to pitch or bitumen coatings reinforced with fabric. The sheathing is applied at the factory. There is however only one thick layer of coating material since the asbestos filler so toughens the bitumen that there is no need to have an additional protection against mechanical damage. It is necessary to roll the coating in sand or whitewash, since there is a greater tendency to distortion by heat than with fabric reinforced coatings.

(7) *Adhesive Bandages.*

(*a*) "C"[3, 29] is a bandage, consisting of grease, "anti-sulphating compounds" and colloidal protecting agents supported by a cotton fabric. Practical tests,[23] and the rotting tests described above, showed that it disintegrated underground, but some gas undertakings are reported to have obtained satisfactory results with it.

(*b*) "D" is a plastic bandage consisting largely of hydrocarbons. It has and retains a high electrical resistance, but is in itself too thin and too easily pierced to give an adequate protection. A proposed outer protection of hessian impregnated with "D" appears to rot[23] too easily.

RELATIVE CORRODIBILITY OF WROUGHT IRON AND STEEL.

After the war there was considerable dissatisfaction in the Gas Industry with the quality of service pipe supplied. Not only was scrap from war materials being used, but it was thought that modern methods did not give such a good quality virgin metal. Alleged wrought iron often contained steel mixed with it.

In 1925 the Wrought Iron Tubing Inquiry Committee of The Institution of Gas Engineers published a report[30] which dealt particularly with the internal corrosion of service pipes, a matter which is of decreasing importance as the drying of gas becomes more general.

The danger from internal corrosion is not so much the development of leaks as the formation of a loose dust of iron oxide, which blows along the pipes and blocks up appliances. It is possible that wrought iron, with its banded structure, shows less tendency to form a loose dust than does steel. But in the case of external corrosion, this difference is no longer significant, and the Committee's

decision that wrought iron is preferable to steel cannot be considered to apply.

A study of the literature from 1880 till the present time suggests that there is no appreciable difference between the quantitative corrodibilities of wrought iron and steel. Only three publications favour wrought iron,[31, 32, 33] and one of these cannot claim to be commercially impartial.

The remaining publications[34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 57, 60] indicate that there is no essential difference between the corrodibilities of wrought iron and steel—in some media one is slightly better, in other media the other.

The most comprehensive investigation on this subject was undertaken by the U.S. Bureau of Standards in 1922.[50, 51, 52] Several thousand samples of different metals were buried in 46 different types of soil, all over the U.S.A. The investigation is still continuing, a number of samples being removed after different periods. The results obtained show conclusively that there is no appreciable difference between the relative corrodibilities of wrought iron and steel.

Steel service pipes have recently been used with satisfaction in England[53] and the U.S.A.[54, 59]

PRACTICAL TESTS ON PIPE COATINGS.

Practical tests were made on pipe coatings:—

(*a*) to compare the corrodibilities of steel and wrought iron service pipes,

(*b*) to find out whether the electrical resistance test gives a true measure of the protective power of a coating,

(*c*) to compare the efficiencies of different protective coatings with particular reference to electrolytic corrosion.

A number of pipe runs about 12 ft. long, each containing two joints, were buried horizontally 2 ft. underground, see Illustration 1. A bend and a vertical piece of pipe connected each pipe run to the surface, and hence through a lead covered cable, to a switchboard. The other end of each run was closed and protected by pitch. A lead grid was buried 1 ft. above the pipes, and was also connected to the switchboard.

The pipes were divided into two sets buried separately. In one set an impressed potential difference of 4 volts was maintained between lead grid and pipes, the pipes being positive. In the other the potential difference was only applied for a few seconds at intervals for measurement purposes.

The switchboard is shown in Illustration 2. Electric current at 10 volts pressure was supplied by a motor generator. By means of rheostats in series and in parallel with the pipe coatings it was possible to adjust the potential difference (shown on a voltmeter) between pipes and lead grid to 4 volts. A series of plugs, one for each pipe run, functioned as two-way switches. With one set of pipes with the plug in the upper position the normal potential difference of 4 volts was maintained between pipes and grid; with the plug in the lower position a microammeter, fitted with a universal shunt, was put into the circuit, so that the current leaking through any given coating could be measured without disturbing the others.* With the other set of pipes with the plug in the upper position there was no potential difference between pipes and grid; with the plug in the lower position the potential difference was applied and the microammeter put into the circuit to measure the leakage current. To obtain the resistances of the coatings the leakage currents were compared with that through a standard resistance of 150,000 ohms.

TABLE 3.—*Analysis of Soil.*

—	pH.	Water Content in Summer. Per Cent.	Total Soluble Solids. Per Cent.	$CaHCO_3$.	Fe_2O_3.
1	2	3	4	5	6
Top soil from 1st hole. . . .	6·1	16 0	1·5	0·9	0·04
Top soil from 2nd hole. . . .	6·1	17·2	1·5	1·3	0·03
Soil from 2 ft. deep from 1st hole. . . .	6·1	15·5	1·5	1·0	0·05
Soil from 2 ft. deep from 2nd hole. . . .	5·9	12·0	1·4	1·3	0·05

The resistances of the coatings were measured at regular intervals, and reduced to the value for a square foot. After 900 days (or, in the case of some coatings which were buried later, after 600 days) the pipes were dug up, photographed with their coatings on, and rephotographed after stripping.

The soil was made up silt, containing broken bricks, iron scrap, and a lot of organic matter.

Apart from the applied current these are not very severe conditions. The soil is not corrosive—it is dry and only feebly acid. The site was a mains depôt not near a main road; earth movement and vibration were only slight, though occasional heavy lorries and a moving crane close by caused some disturbance.

COATINGS INVESTIGATED.

The coatings investigated are shown in Table 4. Complete sets were tested both with and without impressed potential difference, *i.e.*, 66 pipe runs in all.

* This method of measurement is not entirely satisfactory, but the use of the A.C. Megger had not been introduced when these measurements were started.

TABLE 4.—*List of Pipes and Coatings Investigated.*

—	Size of Pipe. Inches.	Composition of Pipe.	Composition of Socket.	Coating of Pipe.	Coating of Socket.
1	2	3	4	5	6
			BURIED FOR 900 DAYS (OCTOBER, 1931—APRIL, 1934).		
A	1½ and 1	Steel	Wrought iron	Bare	Bare
B	,,	Wrought iron	,,	,,	,,
C	,,	,,	,,	Bitumen hessian coating. Initial resistance > 20,000 ohms sq. ft.	Pitch in metal moulds
D	,,	,,	,,	,,	Pitch in cardboard moulds
E	,,	,,	,,	,,	Cement (1 to 3 of sand) in cardboard moulds
F	,,	,,	,,	,,	"C"*
G	1½	,,	,,	,,	"B"* and insulation tape
H	1½ and 1	,,	,,	Bitumen hessian coating. Initial resistance < 10,000 ohms sq. ft.	Pitch in metal moulds
I	1½ and 1¼	,,	,,	Bitumen asbestos sheathing	Bitumen in metal moulds
J	1¼ and 1	,,	,,	Pitch in wooden troughs with slates to lift pipe off wood	Same as coating of pipe
K	,,	,,	,,	Pitch in wooden troughs without slates to lift pipe off wood	,, ,, ,,
L	,,	,,	,,	Cement (1 to 3 of sand) in wooden trough	,, ,, ,,
M	,,	,,	,,	"C"*	,, ,, ,,
N	,,	,,	,,	"A"* applied over red lead	,, ,, ,,
			BURIED FOR 600 DAYS (SEPTEMBER, 1932—APRIL, 1934).		
O	1½ and 1	Wrought iron	Wrought iron	Galvanizing	Galvanizing covered by pitch in metal moulds
P	,,	,,	,,	Double layer of "D"* and bituminous paint protected by insulation tape	Same as coating of pipe
Q	1	,,	,,	Softer bitumen hessian coating	Pitch in metal moulds
R	1½	,,	,,	Bitumen felt coating	,, ,, ,,

* See Table 1.

TABLE 5.—*Analysis of Tubes and Sockets*

Material.	Analysis. Carbon.	Sulphur.	Manganese.	Result of Etching and Micro Etching.
1	2	3	4	5
Steel pipe—Sample 1	0·135	0·058	0·43	Steel
Corresponding wrought iron socket	0·02	0·047	0·17	Wrought iron
Steel pipe—Sample 2	0·06	0·035	0·37	Steel
Corresponding wrought iron socket	0·05	0·024	0·04	Wrought iron
Wrought iron pipe—Sample 3	0·002	0·015	Trace	,, ,,
Corresponding wrought iron socket	0·025	0·018	0·06	,, ,,
Wrought iron pipe—Sample 4	0·02	0·022	Trace	,, ,,
Corresponding wrought iron socket	0·04	0·0185	0·005	,, ,,
Wrought iron pipe—Sample 5	0·05	0·039	0·11	Poorer quality wrought iron
Galvanized wrought iron pipe—Sample 6	1·80 oz. zinc per sq. ft.			Wrought iron
Galvanized wrought iron pipe—Sample 7	2·3 ,, ,, ,, ,,			,, ,,

ELECTRICAL RESISTANCE MEASUREMENT.

The electrical resistance results are summarized in Table 6, and suggest that:—

(1) Bare pipes give a measure of the resistance of the earth.

normal bitumen and hessian coating, but the bitumen felt coating is rather better.

CONDITION OF PIPES AT END OF TEST.

The final conditions of the pipes and coatings are shown in and discussed under Illustrations 3-57 of Appendix 5.

In general the pipes without an impressed current show very little corrosion.

The order of merit of the coatings—deduced solely from the appearance of the pipes with an impressed current—is given in Table 7.

TABLE 7.—*Order of Merit of Coatings from Appearance.*

Degree of Coating.	Coatings.
1	2
(*a*) Complete protection	Bitumen asbestos sheathing, pitch troughing, "D" and "B" with insulation tape, bitumen felt coating.
(*b*) Very good protection	Bitumen hessian coating, softer bitumen hessian coating.
(*c*) Partial protection	"C."
(*d*) Very slight protection	Cement troughing, "B" and insulation tape, galvanizing.
(*e*) No protection	"A."

It should be emphasized that these results only refer to electrolytic corrosion. The order of merit obtained in a very corrosive soil without electrolysis would have been different; galvanizing and cement troughing in particular would probably have appeared higher in the list.

TABLE 6.—*Electrical Resistances of Coatings.*

Key.	Coating of Pipe	Coating of Socket.	Pipes with Impressed Current. 1. Resistance in Ohms Sq. Ft. Original.	Final.	2. Resistance in Ohms Sq. Ft. Original.	Final.	Pipes Without Impressed Current. 1. Resistance in Ohms Sq. Ft. Original.	Final.	2. Resistance in Ohms Sq. Ft. Original.	Final.
1	2	3	4	5	6	7	8	9	10	11
	AFTER 900 DAYS.									
A	Bare steel	Bare	300	200	300	300	300	300	300	200
B	Bare wrought iron	Bare	200	200	300	200	200	300	300	300
C	Good quality bitumen hessian coating	Pitch in metal moulds	20,000	10,000	70,000	50,000	40 000	8,000	200,000	2,000
D	Do.	Pitch in cardboard moulds	200,000	10,000	100,000	70 000	100,000	10,000	100,000	2 000
E	Do.	Cement in cardboard moulds	3,000	3,000	2,000	3,000	2,000	2,000	1,000	3,000
F	Do.	"C"	20,000	3,000	30,000	5,000	5,000	2,000	40,000	500
G	Do.	"B" and insulation tape	20,000	2,000			5,000	2,000		
H	Poorer quality bitumen and hessian coating	Pitch in metal moulds	300,000	20,000	50,000	30,000	100,000	10,000	50,000	10,000
I	Bitumen asbestos sheathing	Bitumen in metal moulds	400,000	10,000	300,000	40,000	50,000	20,000	100,000	10,000
J	Pitch troughing with slates	Same as coating of pipe	200,000	500,000	3,000,000	2,000,000	500,000	500,000	20,000,000	4,000,000
K	Pitch troughing without slates	Same as coating of pipe	20,000	4,000	1,000,000	200,000	300,000	100,000	30,000	100,000
L	Cement troughing	Cement troughing	400	400	400	600	400	600	400	300
M	"C"	"C"	4,000	1,000	2,000	200	1,000	400	1,000	500
N	Red lead and "A"	Red lead and "A"	700	300	1,000	300	400	200	400	300
	AFTER 600 DAYS.									
O	Bare galvanized iron	Pitch in metal moulds	300	200	400	600	100	700	100	600
P	"D" and "B" protected by insulation tape	Same as coating of pipe	100,000	100,000	200,000	200,000	5,000	15,000	200,000	30,000
Q	Softer bitumen hessian coating	Pitch in metal moulds	10,000,000	1,000			6,000,000	4,000		
R	Bitumen felt coating	Pitch in metal moulds	20,000,000	100,000			20,000,000	1,000,000		

NOTE.—It will be seen that coatings on pipes without impressed current often show higher resistances—see remarks on electrical endosmosis—Appendix 1.

(2) Good quality bitumen and hessian coating maintains fairly high resistance in most cases, when the joints are protected with pitch in cardboard or metal moulds. The use of cement, "C," or "B" and insulation tape to protect the joints tends to lower the resistance.

(3) Poorer quality bitumen and hessian coating which had been patched up gives as high a resistance as the good quality. This is because cracks in the coating were repaired with hot bitumen before burial; longer tests with greater soil movement would probably have shown a difference.

(4) Bitumen asbestos sheathing gives much the same resistance as bitumen and hessian coating.

(5) Pitch troughing gives a very high resistance and the use of slate supports makes the resistance higher.

(6) Cement troughing has a low resistance.

(7) "C" has a low resistance.

(8) Red lead and "A" has a negligible resistance.

(9) Galvanized pipes have of course a negligible resistance.

(10) "D" maintains a fairly high resistance.

(11) Softer bitumen hessian coating is not as good as the

The order of merit above is roughly the same as that deduced from the final electrical resistances, which is given in Table 8.

TABLE 8.—*Average Final Resistances of Coatings.*

Average Resistance in Ohms Sq. Ft.	Coatings.
1	2
2,000,000 ohms-sq. ft.	Pitch troughing with slates.
500,000 ,, ,,	Bitumen felt coating.
100,000 ,, ,,	Pitch troughing without slates.
90,000 ,, ,,	"D" and "B" with insulation tape.
20,000 ,, ,,	Bitumen asbestos sheathing.
20,000 ,, ,,	Bitumen hessian coating.
2,500 ,, ,,	Softer bitumen hessian coating.
500 ,, ,,	"C."
(Whole lengths not investigated)	"B" and insulation tape.
500 ohms-sq. ft.	Cement troughing.
500 ,, ,,	Galvanizing.
300 ,, ,,	"A."
300 ,, ,,	Bare pipe.

CONCLUSIONS.

(1) Steel and wrought iron service pipes corrode to much the same extent when exposed to electrolytic corrosion, so that both must be protected by a coating.

(2) The order of merit of the coatings investigated judged from the electrical resistances is roughly the same as the order judged from the amount of corrosion by an impressed current after 2½ years' exposure. This suggests that the electrical resistance test gives a reliable measure of the protective power of a coating.

(3) Pitch troughing, bitumen asbestos sheathing, bitumen felt coating, bitumen hessian coating, "D"* and "B"* with Insulation Tape all give good protection against electrolytic corrosion. It is probable however that "D"* would be more easily damaged than other coatings by any subsequent excavation to lay other pipes or conduits. Pitch troughing in metal or cardboard moulds is an adequate method of protecting joints.

(4) Galvanizing, "C"*, cement troughing, "B"* and insulation tape, and "A"* give inadequate protection against electrolytic corrosion.

APPENDIX 1.

THE ELECTRICAL RESISTANCE OF PIPE COATINGS.

The measurement of the electrical resistance of pipe coatings offers certain difficulties.

The Wheatstone Bridge method using alternating or direct current is unsuitable for high resistances (1,000-1,000,000 ohms), and is too complicated for routine testing.

The straightforward method, using an ordinary D.C. Megger, or an electric battery with a sensitive ammeter to measure the leakage current, has been widely used, but does not give consistent results. The leakage current is seldom steady, but either increases or decreases for some time after the voltage is applied. It is customary to take the reading after one minute,[9] but this is not very satisfactory, since the rate of change varies considerably with different coatings. Very different results are obtained using different voltages, and according as the pipe is positive or negative. These unsatisfactory variations are attributed to three effects:—

(a) *Polarization.*[9, 19]—The resistance increases with the time of application of the E.M.F., and will depend on the direction of the current. This effect is more important when low voltages are used, and with coatings of low resistance.

(b) *Absorption Current.*[9]—The pipe wrapping functions as a leaky condenser which takes up to an hour to charge up; this charging up current appears as a leakage current on the galvanometer. The apparent resistance will increase with time as the charging up current dies down.[9]

(c) *Electrical Endosmosis.*[10, 19]—A film of water in contact with a surface acquires an electrical charge, and accordingly moves in an electric field. The effect is most noticeable in capillaries, where a larger proportion of the water is in contact with the surface. Usually the water acquires a positive charge, so that it moves to the cathode. Water is also carried to the cathode by ions, owing to the greater solvation of cations than anions. This movement of water is the most important factor in upsetting D.C. measurements on pipe coatings—the movement is greater with higher voltages and with longer time of application, and the direction of the current decides whether water is driven into or out of the coating, *i.e.*, whether the resistance falls or rises.[19]

These variations, which may amount to 100 per cent., do not prevent the distinction between high and low resistance coatings, but it was felt that a method which would give more consistent results was desirable.

The above disturbing effects can be avoided by using alternating current, but the effect of capacity is a new complicating factor[19] (inductance can be neglected).

The capacity of a pipe coating may be calculated by treating it as a cylindrical condenser:—

$$\text{Capacity} = \frac{le}{2 \log. \frac{r_1}{r_2}} \text{ e.s.u.} = \frac{le}{2 \log. \frac{r_1}{r_2}} \times \frac{10^9}{9 \times 10^{20}} \text{ farads}$$

where l = length of pipe immersed, e = dielectric constant, r_1 = external diameter, r_2 = internal diameter.

Assuming that $e = 3$ for asphalt,[18] and that the thickness of the coating is only 1 mm., the maximum capacity of the coating on a test piece will be 0·02 microfarads. A more typical value is 0·0008 microfarad.

Some tests were made with an A.C. Megger working at 75 cycles and 100 volts to find out what results would be obtained with a known resistance and capacity in parallel. The theoretical impedance is $\sqrt{\frac{1}{\frac{1}{R^2} + c^2 p^2}}$ where R is the resistance in ohms, c is the capacity in farads and $\frac{p}{2\pi}$ is the frequency.

TABLE 9.—*Measurement of Resistances with 75 Cycles Megger.*

Capacity and Resistance in Parallel.		Resistance Observed with 75 Cycles A.C. Megger.	Calculated Impedance.
Capacity in Microfarads.	Resistance in Ohms.		
1	2	3	4
0·002	100,000	100,000	100,000
0·002	1,000,000	800,000	730,000
0·01	100,000	85,000	90,500
0·01	1,000,000	300,000	285,000
0·1	100,000	12,000	20,800
0·1	1,000,000	12,000	21,300

The calculated impedance is of the same order as the resistance observed.*

It appears that already at 0·01 microfarad and 100,000 ohms the observed resistance is 15 per cent. below the true ohmic resistance. For this reason Evershed and Vignoles were asked if they could make an A.C. Megger using a lower frequency. The resulting 15 cycles instrument gave more satisfactory results.

TABLE 10.—*Measurement of Resistances with 15 Cycles Megger.*

Capacity and Resistance in Parallel.		Resistance Observed with 15 Cycles A.C. Megger.	Calculated Impedance.
Capacity in Microfarads.	Resistance in Ohms.		
1	2	3	4
0·01	100,000	100,000	100,000
0·01	1,000,000	980,000	730,000

APPENDIX 2.

DETAILS OF METHODS OF TESTING COATINGS AND OF MATERIALS USED.

METHODS OF TESTING COATINGS.

A few samples out of each consignment are tested as is described below.

(a) Mechanical Strength and Electrical Resistance.

The pipe or main is placed in a horizontal position and struck by a blunt chisel weighing 5 lb. falling from a height of 10 in. The coating is then immersed in water at room temperature for 72 hours, and after this period must have an insulation resistance of not less than 10,000 ohms-sq. ft.

Service pipes are immersed in water as shown in Figure 1. One end of the pipe is closed with a bung, and sealed by being dipped three times in molten pitch. The pipe is then stood in the tank of water shown with its sealed end downwards. After 72 hours the electrical resistance is measured between the exposed end of the pipe and the tank. The area of pipe immersed is taken as $\pi \times d \times l$ sq. ft., where d is the external diameter of the uncoated pipe in feet, and l is the length of pipe immersed measured from the top of the pitch seal. The resistance is expressed in ohms-sq. ft., and is obtained by multiplying the resistance measured by the area immersed.

Mains are investigated as shown in Figure 2. The main is placed in a horizontal position, and a bottomless tin is fixed on to the surface by means of a plastic bandage ("C" is a convenient material) and a little vaseline. The tin is filled with water, and the electrical resistance is measured between the water and the main. The area immersed is equal to ¼ sq. ft.

The Megger used was supplied by Evershed and Vignoles, and is shown in Illustration 58. It works at 100 volts pressure with a frequency of 15 cycles at 160 revolutions per minute. The scale reads from 0-20 Megohms,

* See Table 1.

* Better agreement cannot be expected for two reasons:—

(1) The instrument does not give a pure sine wave current.

(2) The alternating current in the external circuit is commutated to direct current inside the instrument. Any capacity in the external circuit causes a change in phase, so that the commutator does not pick up the maxima of the alternating current.

and has a divide by 100 shunt for low resistances. The instrument is quite robust, and weighs under 8 lb.

(b) Uniformity, Adhesion, Overlap, Impregnation.

The coating is examined to ensure that 1½-2 in. at each end of the pipe is left bare for gripping tools.

The impregnated hessian is stripped off the pipe and the bitumen underneath is examined to see whether it remains adhering to the pipe. The overlap of the hessian is measured; it should be at least half an inch. The hessian

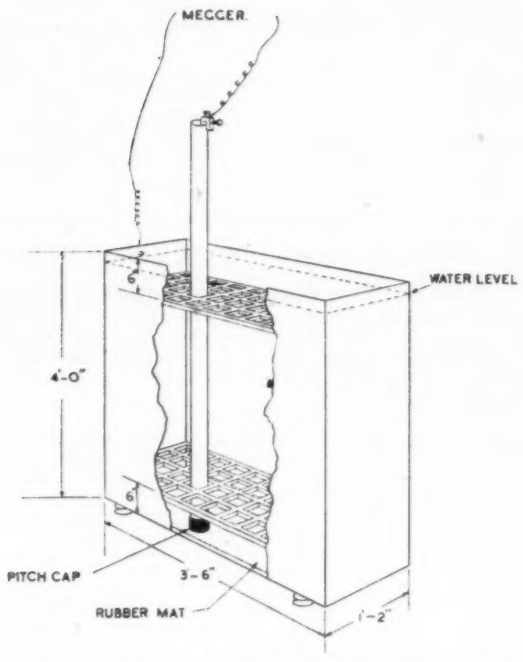

FIGURE 1.—*Measurement of Electrical Resistances of Coatings on Service Pipes.*

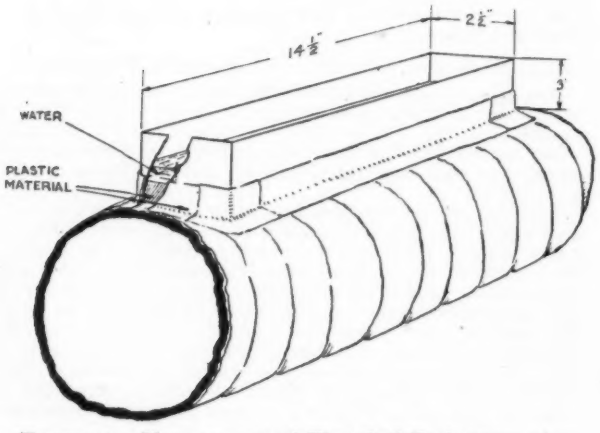

FIGURE 2.—*Measurement of Electrical Resistances of Coatings on Mains.*

is examined to see whether any fibres remain white indicating inadequate impregnation.

(c) Distortion by Heat.

The softening temperature of the coating is investigated by removing two pieces approximately 1 in. × 1 in. square, and placing them with their outside faces together one above the other in a thermostatically controlled air oven. A 10 lb. weight is placed on the samples and left for 1 hour at 115° F. After this period the samples should be easily separable.

APPENDIX 3.

METHODS OF APPLYING COATINGS AND OF BURYING COATED PIPES.

PITCH TROUGHING.

Pitch troughing is only used normally for service pipes.

After the pipe is connected up an open trough is made of wood sufficiently wide to allow at least ½ in. clearance all round the pipe. The trough is made in sections which are placed round the pipe, and secured in position with earth and stones; insulating half rings are inserted to keep the pipe central with regard to the trough; the sections are luted together with mainlayer's clay, and the ends of the trough are closed with bits of wood and mainlayer's clay.

The pitch is melted in a bucket on a coke brazier, or a gas heater; it should not be heated above 350° F. The trough is filled with molten pitch; an interval is then allowed for the pitch to cool and contract, after which the trough is refilled with pitch. In the case of services on a slant it is necessary to put a lid on the trough, and pour from the upper end.

It is difficult to carry out pitch troughing in wet weather; the damp wood fills the pitch with bubbles of steam which cause spitting and weaken the pitch; the pitch does not adhere well to a wet pipe.

PROTECTING JOINTS.

It is necessary to protect the joints of bitumen hessian coated mains or service pipes with hot pitch. The pipes must be handled gently—care must be taken only to apply tongs to the bare ends of service pipes, and mains should be moved with broad slings rather than chains.

With service pipes the cardboard mould is fixed round the joint, or the metal mould is used after greasing with tallow or whitewashing to prevent the pitch from sticking; any leaks are made good with mainlayer's clay. Hot pitch is added as for pitch troughing. The cardboard mould is left in position, the metal mould is removed after allowing an hour for cooling.

With mains a different type of metal mould supplied by the pipe manufacturers is used; this must also be greased or whitewashed. It is customary to wrap bituminized hessian round the joint before applying the mould, in order to hold the pitch together; this is also done with the larger size service pipes. On large mains the pitch cools rather slowly, and cold water may be poured over the mould, so that it can be removed sooner.

APPENDIX 4.

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ILLUSTRATIONS TO DENSHAM AND SMITH'S REPORT ON PROTECTIVE COATINGS FOR UNDERGROUND PIPES

APPENDIX 5. ILLUSTRATIONS 1 TO 58.

ILLUSTRATION 1.—*Arrangement of Pipes Underground.*

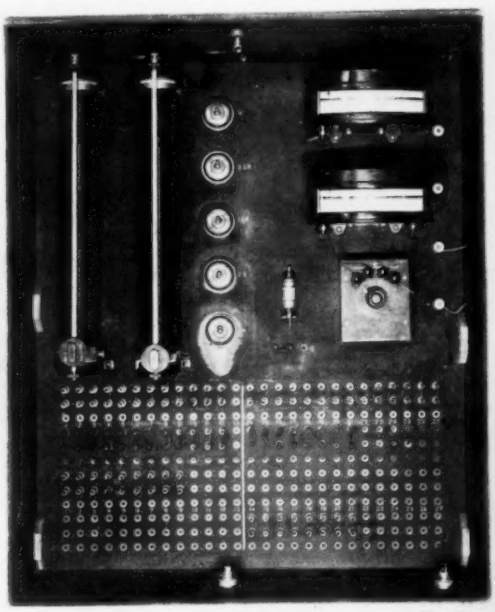


ILLUSTRATION 2.—*Switchboard.*

A. *Bare Steel.*

3 4 5

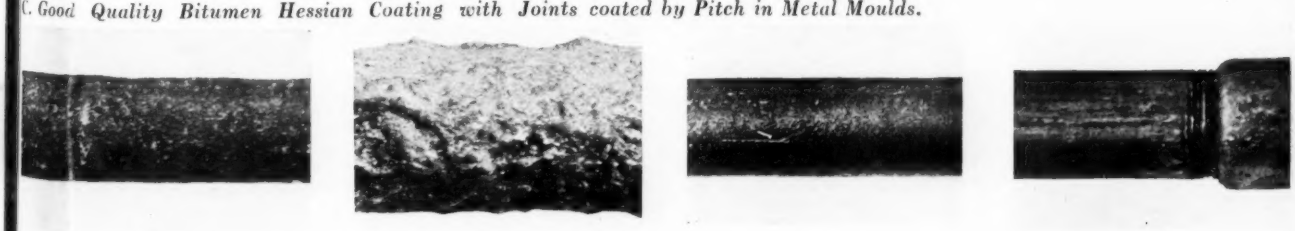
ILLUSTRATIONS 3, 4, 5.—*With impressed current there is very bad corrosion with holes in places—illustrations* 3, 4. *Without impressed current there is no appreciable corrosion, and the red paint is still almost intact—illustration* 5.

B. *Bare Wrought Iron.*

6 7 8 9

ILLUSTRATIONS 6, 7, 8, 9.—*With impressed current there is light corrosion on the* 1*-in. pipe—illustration* 6; *but very bad corrosion with holes on the* 1¼*-in. pipe—illustrations* 7,8. *Without impressed current there is no appreciable corrosion—illustration* 9.

C. *Good Quality Bitumen Hessian Coating with Joints coated by Pitch in Metal Moulds.*



10 11 12 13

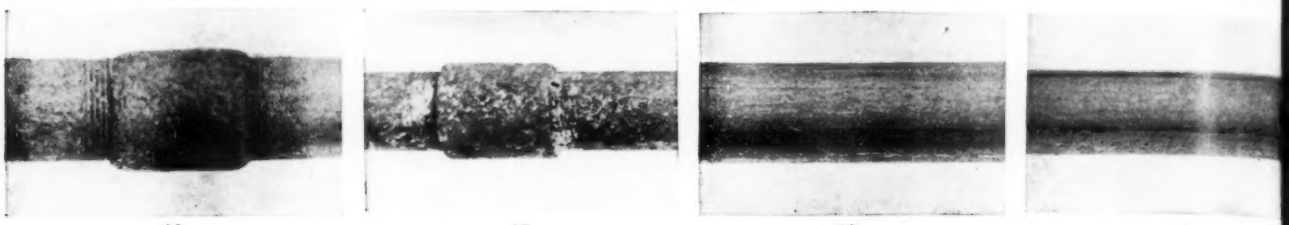
ILLUSTRATIONS 10, 11, 12, 13.—*Neither coatings nor pitch joints show appreciable damage with or without impressed current—illustrations* 10, 11 (*cf. poorer quality coating—illustrations* 26, 27). *The pipes underneath are all quite free from corrosion—illustrations* 12, 13.

D. *Good Quality Bitumen Hessian Coating with Joints coated by Pitch in Cardboard Moulds.*

14 15

ILLUSTRATIONS 14, 15.—*Neither coatings nor pitch joints show appreciable damage with or without impressed current. The pipes underneath are all quite free from corrosion.*

E. *Good Quality Bitumen Hessian Coating with Joints coated with Cement.*



16 17 18 19

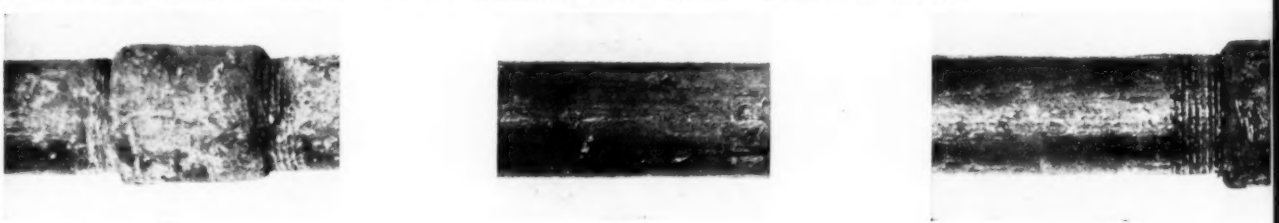
ILLUSTRATIONS 16, 17, 18, 19.—*Neither coatings nor cement show appreciable damage. The pipes underneath with impressed current are corroded at the joints—illustrations* 16, 17, *but are otherwise quite free from corrosion—illustration* 18. *Those without impressed current are quite free from corrosion—illustration* 19.

F. *Good Quality Bitumen Hessian Coating with Joints coated with " C."*

20 21 22

ILLUSTRATIONS 20, 21, 22.—*Neither coating nor " C " show appreciable damage. The pipes underneath with impressed current are corroded at the joints—illustration* 20, *but are otherwise free from corrosion—illustration* 21; *those without impressed current are quite free from corrosion—illustration* 22.

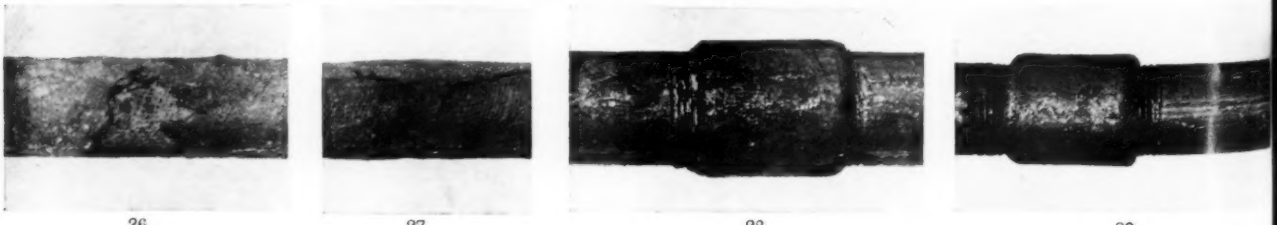
G. *Good Quality Bitumen Hessian Coating with Joints protected by " B " and Insulation Tape.*



23 24 25

ILLUSTRATIONS 23, 24, 25.—*Neither coating nor insulation tape show appreciable damage. The pipes underneath with impressed current are corroded at the joints—illustration* 23, *but are otherwise free from corrosion—illustration* 24; *those without impressed current are quite free from corrosion—illustration* 25.

H. *Poorer Quality Bitumen Hessian Coating with Joints coated with Pitch in Metal Moulds.*



26 27 28 29

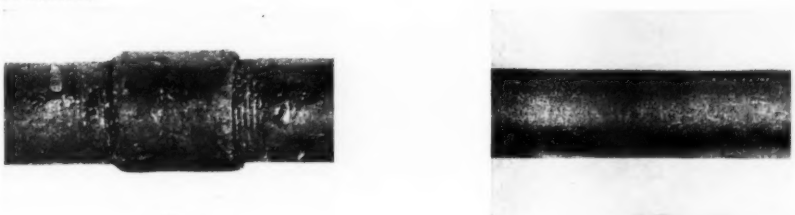
ILLUSTRATIONS 26, 27, 28, 29.—*The coating is damaged in places—illustrations* 26, 27 (*cf. good quality coating—illustration* 10); *the pitch joints are undamaged. The pipes underneath are all quite free from corrosion with or without impressed current—illustrations* 28, 29.

I. *Bitumen Asbestos Sheathing with Joints coated with Bitumen in Metal Moulds.*

30 31 32

ILLUSTRATIONS 30, 31, 32.—*The coating shows slight superficial damage—illustration* 30; *the bitumen joints are undamaged. The pipes underneath are all quite free from corrosion with or without impressed current—illustrations* 31, 32.

J. *Pitch Troughing with Slates.*



33 34

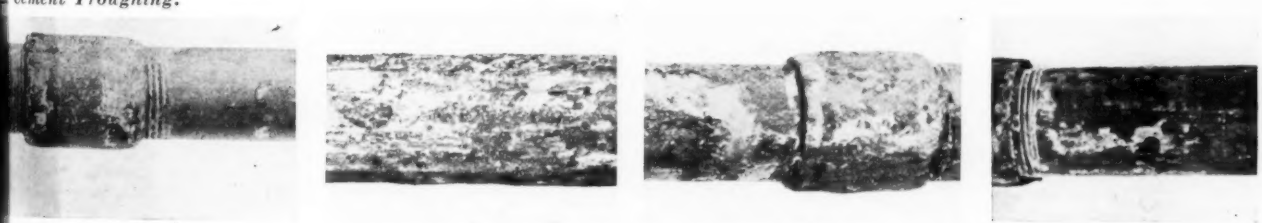
ILLUSTRATIONS 33, 34.—*The troughing appears quite sound both before and after stripping off the wood. The pipes underneath are all quite free from corrosion with or without impressed current.*

K. *Pitch Troughing without Slates.*

35 36 37

ILLUSTRATIONS 35, 36, 37.—*The troughing appears quite sound, but on stripping off the wood it is apparent that the pipe is uncovered in places—illustration* 35. *The pipes underneath are all quite sound with or without impressed current—illustrations* 36, 37.

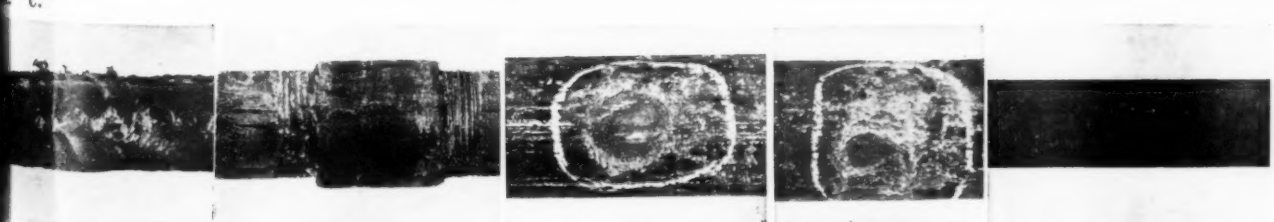
L. *Cement Troughing.*



38 39 40 41

ILLUSTRATIONS 38, 39, 40, 41.—*The troughing appears sound, but the cement is very brittle on the pipes with impressed current. The pipes underneath with impressed current are corroded—illustrations* 38, 39, 40; *those without impressed current are free from corrosion—illustration* 41.

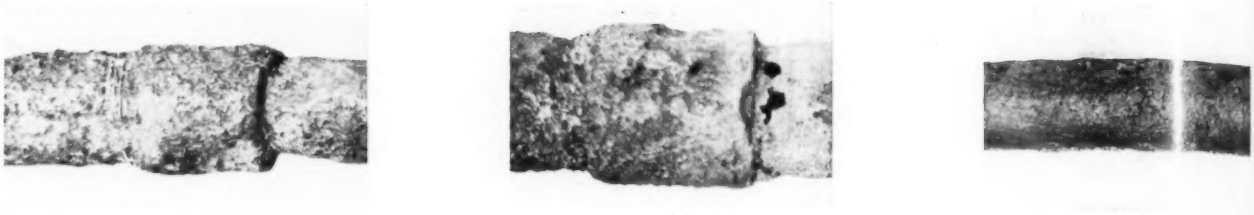
M. *"C."*



42 43 44 45 46

ILLUSTRATIONS 42, 43, 44, 45, 46.—*The "C" coating is fairly intact, though torn in places (probably during excavation)—illustration* 42. *The pipes underneath with impressed current are corroded—illustrations* 43, 44, 45; *those without impressed current are free from corrosion—illustration* 46.

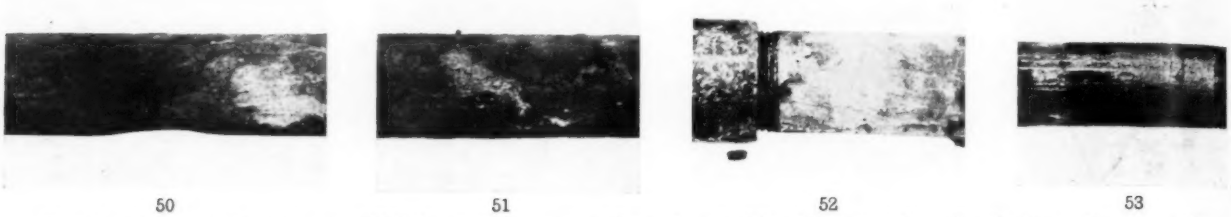
N. *Red Lead and "A."*



47 48 49

ILLUSTRATIONS 47, 48, 49.—*With impressed current there is very bad corrosion with holes in places—illustrations 47, 48. Without impressed current there is no appreciable corrosion—illustration 49.*

O. *Galvanizing.*



50 51 52 53

ILLUSTRATIONS 50, 51, 52, 53.—*With impressed current there is considerable corrosion—illustrations 50, 51, with white deposit round the joints—illustration 52. Without impressed current there is no appreciable corrosion—illustration 53.*

P. *"D" and Insulation Tape.*

54 55

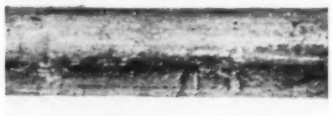
ILLUSTRATIONS 54, 55.—*The coating appears sound, though torn in places during excavation. The pipes underneath are quite free from corrosion with or without impressed current.*

Q. *Softer Bitumen Hessian Coating with Joints coated by Pitch in Metal Moulds.*

56

ILLUSTRATION 56.—*Neither coating nor pitch joints show appreciable damage. The pipes underneath are all quite free from corrosion with or without impressed current.*

R. *Bitumen Felt Coating with Joints coated by Pitch in Metal Moulds.*



57

ILLUSTRATION 57.—*Neither coating nor pitch joints show appreciable damage. The pipes underneath are all quite free from corrosion with or without impressed current.*

ILLUSTRATION 58.—*15 Cycle A.C. Megger.*

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Gas Industry Research

by
Dr. E. W. SMITH

In an article which he contributed to *West's Gas* Jubilee Number, which was reviewed in last week's "JOURNAL," Dr. E. W. Smith, C.B.E., discussed recent developments in the industrial use of gas, and referred to the organization of the Gas Industry to deal with utilization technique and development. This latter section we reprint below.

When it comes to organization we cannot consider the industrial use of gas apart from other activities of the Gas Industry. The development of utilization technique can be treated as a whole provided its relationship with other sides of the Industry's work is not neglected. Within this whole at least five separate types of activity must be catered for:

(1) Fundamental research and uninterrupted long-term programmes.
(2) Type testing and routine testing (if considered necessary, on a national scale) of standard appliances.
(3) Development of new standard appliances.
(4) *Ad hoc* development, particularly of industrial and commercial plant, and work on current problems.
(5) The collection and distribution of available information.

Fundamental research and long-term programmes cannot be really successfully carried out by a laboratory attached to a commercial undertaking. The work suffers from too many interruptions and is too closely associated with routine work. Experience at Watson House will, I think, confirm this. In other industries such work is generally done by a research association with a director and permanent staff, which farms out some problems to universities. Such research ought to be paid for by the whole Industry, undertakings and plant-makers alike.

Type testing and routine testing of domestic appliances and fittings are now carried out by some of the larger undertakings, and this has the effect of keeping the manufacturers up to the mark to some extent. However, the system needs more careful organization in order to give the benefit of the work done to consumers all over the country. Routine testing is most economically carried out at the large makers' works under outside supervision.

The development of new standard appliances is probably most effectively carried out by the same personnel which does the type testing. While both type and routine testing require the close co-operation of the makers they have to be controlled, in detail at least, by the undertakings, who should be unbiassed buyers.

Ad hoc development work on industrial and commercial problems is, as experience with the industrial centres shows, inseparable from questions of commercial policy and must, therefore, be controlled by the undertakings as the Industrial Centres now are. In practice, of course, the Centres can call on the makers for information when they require it, and personal contact is essential.

The collection and distribution of information to be effective demands some sort of organization, like the Industrial Centres, served by a central information bureau. All that is required therefore, is an enlargement of the scope of the present organization.

Any development of the organization of the Industry brings up two fundamental questions. Who pays? And who is in control? Possible payers are the undertakings, the makers, and the Treasury. Control is generally vested in a corporate body such as one of the national bodies, a council—either representative or functional—and a permanent staff. The constitutions of the national bodies are so comprehensive that each could, if necessary, control almost any conceivable new organization. Constitutional arguments are, therefore, of little interest and must give place to expediency. The essential differences between the bodies is that the British Commercial Gas Association and the National Gas Council are controlled and supported by undertakings and their representatives, The Institution of Gas Engineers by individual men as such (though they now receive money from the common fund) and the British Gas Federation by undertakings and makers or their representatives.

It seems to me that, fundamentally, the development of the utilization of gas is the concern of both undertakings and makers as such, and that on general considerations the British Gas Federation is the right body to control it. One proviso is, however, very necessary—that individual makers cannot have representation on committees such as the Industrial Centres Committee, which deal with the commercial policy of undertakings and which have to discuss the relative merits of various makers' plant. The example of the American Gas Association shows that such a proviso presents no great difficulty.

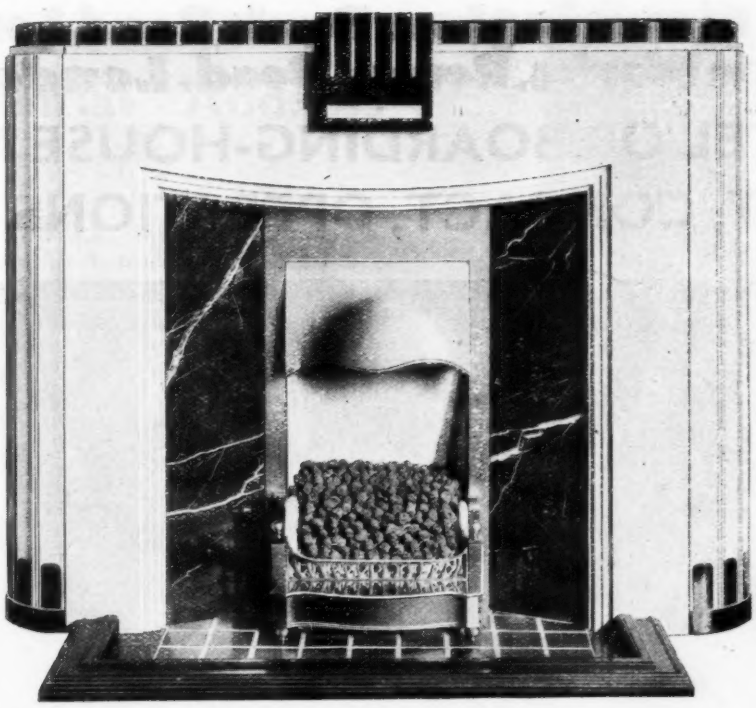
The idea of having a research association, run in conjunction with the Department of Scientific and Industrial Research, has much to recommend it. As mentioned before, a separate organization is really required to carry out fundamental and long-term research, and to direct the work carried out on behalf of the Industry at universities such as Leeds. If this body were a research association, not only would the Treasury subscribe a certain amount towards it, but the Gas Industry would then be on an equal footing with the other industries which have research associations—*e.g.*, the electrical industry, the non-ferrous metals industry and the paint and varnish industry. The main advantage of this would be that the Gas Industry would be able to exchange information with the other industries instead of having to buy it. Considering the number of research associations to which the Gas Industry might profitably subscribe, and how high the subscriptions would be, this is a point well worth considering. We are apt to grumble that the Government helps the electrical industry unduly, but we have not yet thought fit to accept what the Government has offered. The electrical industry has done so and, in fact, the British Electrical and Allied Industries Research Association is the largest research association and, therefore, presumably draws the largest grant from the Treasury.

I suggest, therefore, that a British Gas Industry Research Association be formed along the same lines as the other research associations and financed jointly by the British Gas Federation (from the central bodies general fund and the Society of British Gas Industries) and the Department of Scientific and Industrial Research. The association would carry out only fundamental and long-term research work and would deal, on the utilization side, with such subjects as combustion, heat transfer, corrosion, the development of new materials (presumably excluding refractory materials which are already dealt with by the British Refractories Research Association), the composition, control and properties of furnace atmospheres, methods of removing organic sulphur from town gas, and the effects of impurities in town gas on appliances in use.

Further, I suggest a system of Centres as proposed by Messrs. Lacey and Masterman in their Institution Paper, but co-ordinated by a British Gas Federation committee. Thus, there would be an Industrial Centres Committee co-ordinating as at present ten Centres, a Domestic Centres Committee co-ordinating ten or fewer similar Domestic Centres run by the same undertakings, and an Illumination Centres Committee co-ordinating ten or fewer Illumination Centres. The Industrial Centres would cover much the same ground as at present. The Domestic Centres would be supplied with tests results from the central information bureau and would assist local undertakings in the selection of suitable appliances, in framing their domestic selling policy, in training ther selling staff, and in dealing with special problems and difficulties. The Illumination Centres would act in a similar capacity and would, in addition, be in a position to help to prepare street lighting schemes for submission to local authorities.

Testing would have to be controlled by another committee parallel to the Centres Committees and including representatives of the British Standards Institution. It seems most practical that the actual type-testing work should be done by one, or perhaps two, of the largest Domestic Centres. The other centres would have to contribute towards the cost of this work and in return would be allowed access to all results, and would be allowed to send representatives to the testing laboratories to see that the work was done to their satisfaction. The same centre, or two centres, would handle the development of new standard appliances in conjunction with the makers. Routine testing would have to be organized by the testing com-

TALKS ON HEATING APPARATUS



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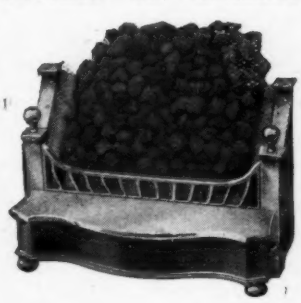

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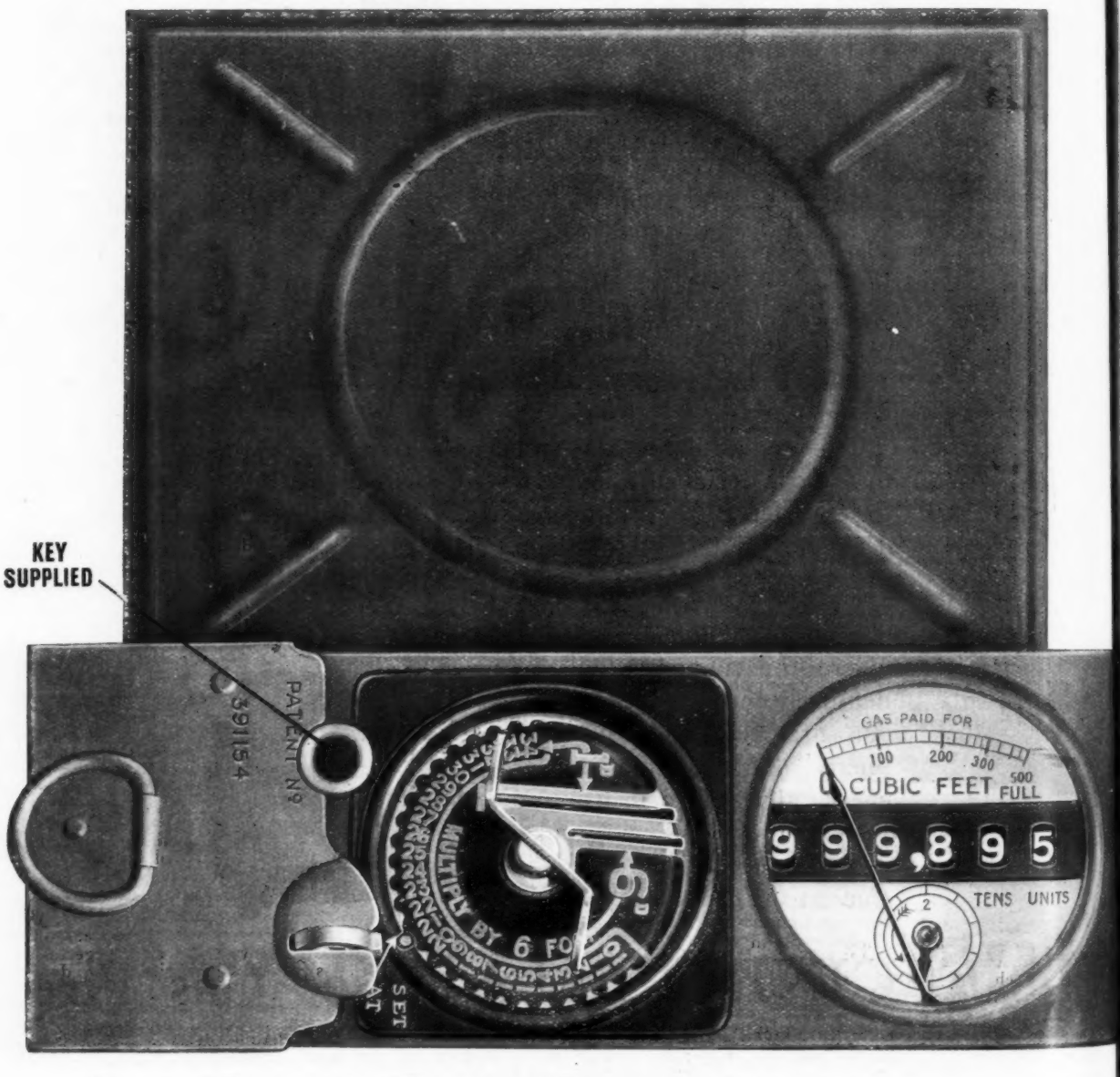

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mittee and would consist, as far as possible, of supervising standard routine tests at the makers' works. Centres would be provided with type-test results and would be able to base their advice to undertakings on the assumption that production models conformed to these results. The same permanent staff would be responsible for servicing the committees and the central information service. The latter can be organized on lines very similar to those already adopted by the Industrial Centres and their information bureau.

I am much indebted to Mr. J. C. Hoksin, of the B.C.G.A., for valuable assistance in preparing this contribution.

THE ASSOCIATION OF PUBLIC LIGHTING ENGINEERS

Presidential Address

OF

A. MAURICE BELL, Assoc.M.Inst.Gas E.
(Public Lighting Superintendent, Tottenham and District Gas Company)

Delivered at the Twelfth Annual Meeting and Conference of the Association held in London from Sept. 9 to 12.

THE PRESIDENT

In opening my Address I wish to express my sincere appreciation of the signal honour which you have conferred upon me in electing me as President of this Association. I assure you that I am not unmindful of the responsibility involved in this task. In accepting that responsibility, however, I am fortified by the confident belief that, like my predecessors in office, I shall receive your co-operation and aid in furthering the interests of our Association and in increasing its usefulness—both to its own members and to the community whom we desire to serve and benefit.

It is fitting to recall that this, the Twelfth Annual Meeting and Conference of our Association, is the first to be held in London since the original meeting, which I attended and which I well remember. The founders of the Association may rightly feel some gratification and pride in the fact that it has made such substantial progress during so short a period of existence. During the last few years this progress has been specially marked, as is shown by the fact that the attendances at our Annual Conferences have increased year by year, and that, on the present occasion, our record of numbers has once more been surpassed. We have with us, as usual, leading Public Lighting Engineers and representatives of Local Authorities from all parts of the British Isles, and it is our special pleasure to welcome delegates and visitors from abroad—one of whom, Dr. Adolph, has accepted our invitation to present an account of the developments of public lighting in Germany. This is a happy choice at the present moment, when some of our members have only recently returned from the eminently successful meeting of the International Commission on Illumination in that country. It may be recalled that two years ago Monsieur Partridge contributed a similar account of public lighting in Paris. I trust that the practice thus initiated will be continued and that the Association, in years to come, will be informed in turn of the progress in public lighting in all parts of the world.

Other Papers are to be presented dealing with technical aspects of public lighting. I feel, therefore, that I shall not be expected to enter too deeply into intricate technical points, and I shall, instead, try to fulfil the purpose of a Presidential Address by contributing a survey of some of the main topics that are in the minds of most of us to-day. It occurred to me that it would be useful to touch on several of the chief changes and developments that have taken place since the formation of our Association.

Public Lighting and Road Safety.

Under modern conditions the material progress of a nation is measured largely by speed, but speed must be harnessed to safety, and public lighting must be so developed as to become the handmaiden of the one and the agent of the other.

During the past decade one of the dominant factors—which has brought with it other changes profoundly influencing public lighting—has been the enormous development in the volume and speed of motor traffic. This development has not only led to an entirely new technique in the use of roads (so that to-day driving a vehicle on main thoroughfares tends to become more and more a mechanical process and the roadways themselves more and more resemble railways) but has unfortunately brought in its train a progressive increase in the number of road accidents, a fact familiar to everyone, though the seriousness of the position is perhaps not yet even fully understood. From data furnished by the National " Safety First " Association, it is evident that the number of accidents has increased almost continuously year by year, with the result that the annual figures (both for fatal and non-fatal accidents) have roughly doubled during the last ten years. During the year 1934, 7,343 persons were killed and 231,603 injured on the roads in Great Britain. It is small wonder that the Ministry of Transport is exploring every possible method of diminishing the annual death-roll.

In a very recent report on road accidents prepared by the police throughout the country for the Ministry of Transport, and which received considerable publicity in the Press, it is interesting to note that the worst period of the day for accidents is between 5 p.m. and 6 p.m., and the second worst period between 6 p.m. and 7 p.m. To us it is important to understand that the report was compiled from statistics covering the first few months of this year. The mean time for the lighting of street lamps during that period was 5.40 p.m. From these deductions the conclusion arrived at is, in fact, that the worst period falls between sunset and darkness, or during and just after the change-over from natural to artificial light before road users become accustomed to the altered conditions of visibility rendered by—shall I say—good, bad, or indifferent public lighting. This emphasizes a problem upon which we must concentrate in an endeavour to solve what may be regarded as a definite daily period of danger.

We, as Public Lighting Engineers, are interested chiefly in the part that public lighting can play in increasing the utility of roads and enhancing their safety. If it be true, as a recent enquiry in the United States has suggested, that " the night-hazard is roughly four times the day-hazard," the need for good road lighting is surely evident. Analysis of statistics, such as those prepared by the National " Safety First " Association in 1933 and by the Ministry of Transport in the subsequent year, with a view to establishing the influence of lighting conditions, is itself something of a hazard! Much discretion is needed in the interpretation of these statistics. For example, while we all believe that, other things being equal, better lighting must lead to greater safety, it may well happen that it also enables motorists to proceed at greater speed or leads

to an increase in the volume of traffic (cases have been mentioned in which better lighting of a new by-pass road has been installed with the deliberate intention of diverting traffic and has achieved this end). A road may be so badly lighted as to be shunned by traffic. It might thus be relatively free from accidents, though of little service to the community. The first object of street lighting is to render motor traffic safe by removing as far as is possible the principal cause of accidents—inability to see clearly at night—because one fact that does seem to emerge from the investigation of statistics is that the proportion of accidents occurring at night has tended to increase year by year. This, of course, does not mean that public lighting has deteriorated, but that the volume of night motor traffic has risen enormously. The inference is that good artificial lighting on the roads is even more important than in the past.

Higher Values of Illumination Justified.

At this stage I would like to quote an effective comparison that has occasionally been used to illustrate the need for better public lighting. So far back as 1922 the Home Office Departmental Committee on Lighting in Factories and Workshops recommended five foot-candles as the minimum illumination desirable for fine work—a value which in the present day is often substantially exceeded. A street such that no part receives less than 0·05 foot-candles (Class "F" in the British Standard Specification) would, under present conditions, be considered relatively well lighted. Yet this value is only one hundredth of that named as the minimum for industrial lighting and is actually less than one ten-thousandth of the average value furnished by daylight from an unobstructed white sky. In my opinion no street carrying any material volume of traffic should be lighted to a lesser intensity than that corresponding to Class "F." In view of the above comparison, and the evident speed and complexity of motions of modern traffic (certainly comparable with processes in some factories), it is difficult to understand how *any* installation of street lighting under present conditions—even one fulfilling the requirements of the highest class according to the specification—can be condemned as "extravagant," even if, for reasons of economy, it may be difficult to secure. Councillor Reid, of Aberdeen, welcoming the Conference last year, summed up this side of the question in a "nutshell," when he said: "No matter how much we spend on street lighting, if it is going to save a life, it is worth it."

I do not, of course, wish to convey the impression that the provision of a certain minimum illumination is all that is necessary to ensure a well-lighted street. When one looks back on conditions prevailing when our Association came into existence, one realizes how much research has since been done both in regard to the design of fittings and equipment and in the analysis of the factors which constitute good lighting. One point that is much better appreciated now is the distracting effect of glare from unduly brilliant or imperfectly arranged lights. Another is the changed viewpoint in regard to the desirability of extreme uniformity of illumination between post and post—a change occasioned mainly by recognition of the effect of the highly polished road-surfaces of dark texture with which we are now familiar.

Influence of Road Surface.

While we are all agreed that a light-coloured road surface would be of a great advantage, if we could get it, there is some variety of opinion in regard to polish—which some consider a positive advantage. At the moment there would seem to be two schools of thought—that which holds to the ideal of general illumination of objects in the same manner as is effected by daylight, and that which pins its faith mainly to achieving even and high road brightness so that objects are revealed silhouetted against this brighter background. These views may find expression in some of the Papers to be set before us.

One difficulty that has to be faced in studying the brightness of road surfaces—and especially in any effort to include this important factor within the scope of a specification—is the extraordinary difference in appearance of a road in a wet condition, as compared with its aspect when dry. A road which is quite satisfactorily illuminated on a dry night—such as is ordinarily selected by viewing committees—may appear very different after heavy rain, when unexpected regions of "blackness" may be revealed, as the point of view of the observer changes. In such circumstances it may well happen that an alteration in the position of one or two lamps may make all the difference between obscurity and comparative safety, especially where a bend in the road occurs. In this connection the impression caused by the lights themselves at distant bends in the road should be studied. Under some conditions they may easily mislead drivers in regard to the actual course of the road. Such points as these require detailed study by the Public Lighting Engineer.

While appreciating that road surface brightness is a vital factor when the convenience of motor traffic is the main consideration I may also point out that on other types of roads—*e.g.*, in the shopping centres of a city, or in purely residential areas with little traffic, different aspects may prevail. Therefore, in any general conclusions on street lighting conditions, I would like to see a combination of these two outlooks, rather than exclusive reliance on either.

Greater Uniformity Needed.

I have explained that modern views of public lighting on the whole tends to attach less importance to extreme uniformity of illumination from post to post—a condition which may in any case be nullified by the behaviour of the polished roadway, and by the variation in its behaviour when dry and wet. There is, however, another form of uniformity which we should certainly seek to secure—namely, the elimination of abrupt changes such as may occur in passing from one road to another, or even within a few miles on the same road, when this is lighted by different authorities. These extreme divergences arise not only from varying intensities in the lights themselves, but also from the variety of positions assigned to them, and other departures in method. Four years ago a London coroner observed "there are spots all over London where lighting conditions have not been adapted to the altered circumstances caused by the advent and rapid development of motor traffic." There is still ground for serious criticism. The variations I have referred to undoubtedly constitute a contributory cause of accidents. They could be eliminated to a great extent by the general application of the British Standard Specification and by systematic classification of roads in each area. The specification, now in course of revision, already forms a valuable basis of classification of roadways. Personally, I attach great importance to the "evening up" of illumination, so as to eliminate great contrasts or at least ensure that changes in brightness take place gradually. This is particularly important in passing from a side street to a main street. A driver, in such circumstances, is particularly apt to be distracted by sudden changes in brilliancy. Admittedly, however, the "grading" of illumination in such cases needs care; having consulted opticians and others, and received conflicting opinions, I have fallen back on practical tests, but cannot as yet suggest a definite formula. I do not consider that a very high degree of illumination on certain roadways is so valuable as even medium uniform illumination on others. When a certain roadway is very much more brightly lighted than adjacent ones, this seems to create a feeling of confidence and results in increased speed on the part of fast-moving vehicles; whereas a well-planned installation, giving medium and uniform road illumination tends to provide greater safety, because both drivers and pedestrians are more alert. This, at least, seems to me the wisest method until a much higher standard of illumination can be made general.

The Ministry of Transport Committee.

Such problems as these suffice to show that the committee appointed last year by the Ministry of Transport "to examine and report what steps could be taken for securing more efficient and uniform street lighting, with particular reference to the convenience and safety of traffic," has commenced its task at an opportune moment. Our Association was invited to give evidence before the committee, and was able to present some instructive data illustrating the extraordinary lack of uniformity that prevails in some areas at the present time. The appointment of this committee, to my mind, was a judicious step. While awaiting its conclusions, we may regard its formation as a gratifying recognition of the national importance of public lighting, and its direct relation to the safety of the roads.

Undoubtedly, at the present moment there is an urgent need for improvement in road lighting. Looking back over the period of existence of our Association, we cannot escape the conclusion that, despite much patient work by Public Lighting Engineers, and notwithstanding certain outstanding improvements, the advance in this field has not been comparable with that in some other fields of lighting. The lighting of shops and stores, for example, where a direct appeal to business considerations is possible, has developed immensely. A new standard has been achieved—because of the recognition that better lighting brings an immediate return in the form of increased and more rapid sales. Suggestions for expenditure on better public lighting do not usually meet with the same ready response. An L.C.C.

authority last year stated that " modern engineering leaves no excuse for bad lighting, and where bad lighting exists, it means there is a fault in the policy of the local authority." Bad public lighting—especially on a main thoroughfare—is a gamble with fate. Every motorist and pedestrian risks a danger. Good and efficient public lighting can be secured if ratepayers will foot the bill. But no money can buy back the lives of those killed, nor restore to health those maimed as a result of inadequate lighting. Records at coroners' inquests occasionally afford evidence of cases in which some defect in lighting has been blamed for a tragedy; I have already quoted remarks of one coroner on the subject, but who can say in how many other instances a failure in judgment or indecision on the part of a driver, due to inability to see clearly, or momentary dazzling by a glaring light, has contributed to an accident?

A Classification of Roadways.

What is mainly needed at the moment is a systematic study and classification of roadways, and their needs in regard to public lighting. Road conditions are changing rapidly and continuously. Vehicular traffic is multiplying in figures undreamed of a few years ago. Lighting units and installations should be planned to meet, not only present-day requirements, but also future eventualities. Most of us could mention instances of roadways, the functions of which have completely altered even during the past ten years. Certain routes which a few years ago were regarded as merely residential, have become important channels for outgoing and incoming traffic. Arterial roads, originally constructed to relieve congestion of traffic in built-up areas, have themselves become thickly populated and highly congested. In such cases road illumination which might have been considered ample a few years ago, has now become obviously inadequate. Arterial roads, too, as I have shown on other occasions, present a particularly difficult problem because they pass through the areas of many local authorities, each acting independently, and not infrequently reluctant to bear the cost of proper lighting of their section of roadway; sometimes they are quite unable to do so. Lack of funds is here a crucial difficulty.

Cost—A Suggested Solution.

In a Paper given some time ago before a large body of municipal officers, I gave my solution. My ideas have not changed, and I repeat that the cost of public lighting, to a standard necessary to meet local requirements, should not fall solely on the local authority, but should be met out of a common fund for the purpose, to which local and county authorities should contribute, and which should be aided by a generous contribution from the Road Fund.

Lighting of roadways should be an integral part of their construction and maintenance. Of a total of 8,760 hours per annum during which roads can be used, the dark hours amount to over 4,000, approximately 46%. Bearing in mind the heavy cost of construction of many such thoroughfares, it is merely judicious expenditure to equip them with lighting that will enable them to be used with safety by night, thus relieving in part the heavy congestion during the day. In the interest of safety, proper lighting should be made compulsory on all roads in and through towns, and on all main arterial roads carrying heavy traffic.

I have already indicated the importance of planning for the future. Public Lighting Engineers regard as part of their normal duties the maintenance of existing installation, and their renovation from time to time by the substitution of more efficient lighting devices. Such " patching up " and many minor improvements by which the ratepayers benefit are often undertaken at little, if any, extra cost. A skilful Public Lighting Engineer can save the authorities considerable sums in this way, and committees would do well to accept the assurance that retaining obsolete and inefficient fittings, when more up-to-date equipment can furnish more light at less cost, is false economy.

But, personally, I am opposed to the patching up of installations that are definitely out of date, not only in equipment but in design. In such cases the only real solution is redesign in accordance with modern methods. In this connection I may throw out the suggestion that agreement on certain principles that should be observed in all new installations might be expedient. In existing installations a compromise, if regrettable, may sometimes be inevitable. But in the case of a new installation let us at least proceed on lines that will ensure lighting, best suited to modern conditions, so far as it can be determined by present experience.

I am now drawing towards the close of my Address. Enough has perhaps been said to indicate the complexity and highly technical nature of the subject of public lighting, to which additions are being made year by year. As an instance, I may mention the illumination of traffic signals and road signs which now frequently fall within our scope. I would like to emphasize most strongly the necessity of adequate illumination of such signs during the period of darkness. In the daytime it is possible for an alert driver, in nearly every case, to see cross-roads, sharp bends, narrow bridges, &c.; but at night, unless roads and signs are properly illuminated, there is the " shadow " of doubt, leaving a margin of error for the motorist or pedestrian to bridge in a split fraction of a second. Light plays an essential part in vision by night, and hence in the safety of the public. Those concerned with road safety precautions would, therefore, do well to take the Public Lighting Engineer in their area into counsel—for assuredly through his duties he knows, or should know, every danger spot on his roads.

The Public Lighting Engineer.

May I also emphasize—what is a point of principle with our Association—the expediency, in towns and cities of any size, of employing a thoroughly qualified Public Lighting Engineer to handle the street lighting. Experience in some of our greatest cities has proved the wisdom of this step. Where the expenditure of public money on lighting is considerable, expert supervision is a whole-time job, and it is my conviction that there is quickly approaching a time when the fully trained Public Lighting Engineer will be in urgent demand to a continually increasing extent. This has been recognized by our Association, which has recently appointed a committee to map out the courses of study for those who wish to enter the profession. I hope that tentative suggestions on this point will be submitted to members during my term of office.

In this connection, I have been asked to say a few words in regard to the future of our Association which has reached such an interesting stage in its career. We are, of course, primarily a professional body. I hope that the number of fully qualified Public Lighting Engineers within our ranks will progressively increase, and that the profession of " Public Lighting Engineer " will, in time to come, be more and more firmly established and recognized. It should be the task of our Association to safeguard the status of the Public Lighting Engineer as a public servant undertaking duties of great importance to the community. In this connection many questions relating to the administration of public lighting, besides its technical aspects, come within our scope. Therefore, it will be understood that we must preserve our distinctive position, and that we could not, consistently with our aims and objects, merge completely with any other organization.

But I am sure that we all recognize that public lighting, while primarily the care and concern of our members, is likewise of interest to other experts as well as to the community. We shall, therefore, gladly co-operate with other bodies in discussions on public lighting and put the special knowledge of our members at their disposal: and the more others will help us to kindle interest in public lighting and promote public appreciation of its supreme importance, the happier we shall be.

The Lighting of London.

Before closing, I would like to draw attention to the opportunity presented at this conference of studying the lighting of London, which offers many features of interest. Not only will you find here some of the finest examples of street lighting in the country, but you will find represented practically every form of lighting as well as warning devices of the most modern pattern. Incidentally the method of administration of the lighting, for which over thirty different authorities are responsible, is probably unique amongst great cities at the present time. I would strongly recommend every member present to make the tour of inspection of the " Lights o' London " by motor coach. The ground to be covered is considerable and has been so selected as to afford a general idea of the positions of the chief installations, so that any of special interest to individual members may be identified and noted by them for more thorough examination before leaving London.

Conclusion.

In conclusion, I should like to put on record my deep appreciation of the aid which the Chairman, Directors, and Chief Engineer of the Tottenham and District Gas Company have given me, and of the facilities they have placed at my disposal in connection with this conference.

I thank you all once more for the signal honour which you have conferred upon me, and which I will do my utmost to merit during my term of office.

Gas Undertakings' Results

Bradford.

The report by the Engineer and Manager, Mr. G. E. Currier, upon the working of the Department for the year ended March 31, 1935, states, the financial statement shows, that the gross income for the year amounted to £430,758 and the gross expenditure to £363,586, showing a gross profit of £67,172. After providing for the following net revenue charges, interest on loans, &c., £27,137, contributions to sinking fund £6,867, and income-tax £10,581, there is a net profit on the year's working of £22,587. In comparison with the figures for the preceding year, the gross income is increased by £12,856, and the gross expenditure by £28,274, while the net revenue charges are less by £15,823. The net profit of £22,587 has increased by £405. During the year £4,350 has been charged to capital account for new mains in the supply area, thereby increasing the total expenditure on this account to £1,475,175. Of this sum £487,385 remains outstanding, £987,790 having been provided for redemption of loans. The amount received for gas was £287,218, or £5,415 less than the previous year. The year under review is the first complete year in which the two-part rate has been in operation, and the reduced revenue is entirely due to the price concession passed to the consumers by the new rate of charge. The total sales of gas for the year have been 1,880,418,000 cu.ft., as compared with 1,840,411,000 cu.ft. in 1934, an increase of 40,007,000 cu.ft., or 2·17%. The increase in output is due to the operation of the two-part tariff. The number of consumers under this system of charge is now over 21,000. The total quantity of gas made was 2,030,389,000 cu.ft., as compared with 1,987,352,000 cu.ft. during the preceding year, being an increase of 43,037,000 cu.ft., or 2·16%. The unaccounted-for gas was 7·38%. The total receipts from residuals are £70,594, or £1,813 more than last year, an increase equal to 0·231d. per 1,000 cu.ft. sold. The receipts for coke (including breeze), after deducting labour and carting costs, were £47,964, or £1,259 more; the average price realized per ton being 16s. 5·94d., as against 16s. 3·55d. last year. Restricted lighting was again adopted during the three summer months at the instruction of the Finance Committee, for which the customary rebate of £1,000 was given. The quantity of gas used for street lighting purposes was 217,864,000 cu.ft., and the total number of gas lamps in use at March 31, 1935, was 12,740, compared with 12,587 a year earlier.

Falmouth.

A net profit of £14,129 14s. is reported by the Directors of the Falmouth Gas Company, and a final dividend of 2s. per share, less income-tax, was paid (making 3s. per share for the year). The sales of gas showed a considerable increase over last year in spite of the mild winter and the decreased consumption of the modern appliances. A record number of appliances have been sold. At the end of the year over 800 of the modern cookers had been sold under hire-purchase terms besides those sold for cash. The Board of Trade has granted permission to use land for gas-works purposes at Ponsharden.

Glasgow.

The report by the Committee on Gas Supply to the Corporation of Glasgow for the year ended May 31, 1935, states that the gross revenue amounts to £1,527,947, and the gross expenditure to £1,254,051, to which is added depreciation written off capital assets, £29,378—£1,283,430: the balance carried to profit and loss account being a credit of £244,518. The Committee had to meet the following requirements during the year: Annuities on stocks £16,544, interest on borrowed money, &c., £39,508, sinking fund £136,522, totalling £192,575, which leaves a surplus on the year's operations of £51,943. The quantity of coal carbonized during the past year was 555,194 tons, as compared with 549,999 tons for the preceding year, an increase of 5,195 tons. The average cost of coal carbonized last year was 16s. 6·397d., being 3·278d. more than the preceding year. The quantity of coal gas made per ton of coal carbonized was 15,347 cu.ft., which, with water gas, gave an average of 15,845 cu.ft., as compared with 15,348 cu.ft. and 15,796 cu.ft. respectively per ton for the previous year. The quantity of gas delivered and accounted-for during the year amounted to 8,851,956,772 cu.ft., as compared with 8,708,911,157 cu.ft. for the preceding year, an increase of 143,045,615 cu.ft., equal to 1·643%. The unaccounted-for gas during the year was 7·01%, as compared with 7·47% for the preceding year. The net sum realized from the sale of coke and breeze this year amounts to £146,473, being £14,699 more than that of the preceding year. The total quantity of coke and breeze sold during the year was 317,492 tons, compared with 247,514 tons for the previous year—an increase of 69,978 tons. The number of meters in use at May 31 last was 333,084, as compared with 329,557 in May last year—an increase of 3,527. Ordinary type meters show a decrease of 3,911, while prepayment meters have increased by 7,438. At May 31 last there were on loan 179,635 cookers and range fittings, 15,872 grills, 48,180 boiling burners, 21,957 gas fires on hire, 5,202 radiators on hire, 1,205 water heating appliances on hire—a total of 272,051, as compared with 282,716 for the preceding year. In addition to the above, note should be taken that the following appliances have been provided and fixed by Housing Authorities and private builders under Government subsidy terms, and these appliances are now in operation in the district: Cooking appliances, 55,690, washboilers, 55,591, and gas fires, 63,019, totalling 174,300.

Inverness.

The annual report of the Inverness Gas Department shows that steady progress was made during the past financial year. The output of gas amounted to 188,615,000 cu.ft., being an increase of 8,521,000 cu.ft. over that of the previous year. On the financial side the results have been no less satisfactory. These show a surplus of £161 instead of an anticipated deficit of £934, as a result of price reductions. Mr. Andrew Thomson, Engineer and Manager, we believe, is advocating the adoption of a block system of charging for gas.

Port Talbot.

The gross profit for the year amounted to £15,047, and the net profit £5,490. During the year reductions in the price of gas have benefited consumers to the extent of £5,050. The capital expenditure during the year was £8,143. Of this amount £6,005 was covered by loan sanction, and the balance of £2,138 was paid from revenue. The total quantity of gas made and purchased was 204,008,500 cu.ft., as compared with 190,276,700 cu.ft. the previous year, being an increase of 13,731,800 cu.ft. or 7·2%. The total gas sold increased from 172,796,400 cu.ft. to 185,931,100 cu.ft., the increase amounting to 13,134,700 cu.ft., equivalent to 7·6%. Gas unaccounted for shows a decrease from 8·2% to 7·9%. The total coal carbonized is 9,230 tons, and the gas made per ton of coal is 21,680 cu.ft., equivalent to 92·1 therms. This compares with 8,623 tons the previous year, when the gas made per ton was 21,661 cu.ft., or 92·0 therms. The total amount paid for coal increased from £7,647 to £7,691, an increment of £44. The revenue from residuals increased by £239 to £3,686, despite the reduced prices obtained for tar. Sales of fittings and appliances have risen to £9,714 from £7,061, the increase being £2,663. A total of 739 new consumers have been connected during the year, bringing the total to 8,373.

Singapore.

The report of the Engineer of the Singapore Gas Department, Mr. F. Bedford, for the year ended Dec. 31, 1934, states that the revenue from coke was $39,184.33 against $44,977.58 for 1933, the average price per ton being $18.67 against $21.67 for 1933. The revenue from tar was $19,678.96 against $15,083.52 for 1933. The tar made per ton of coal was 11·6 gallons against 9·7 gallons for 1933. The amount of gas manufactured was 286,800,000 cu.ft. against 277,795,000 cu.ft. during 1933, an increase of 3·2%. Of the above quantity 92,085,000 cu.ft. was water gas, equal to 32·1% of the make. The calorific value of the gas supplied is 500 B.Th.U. per cu.ft. The cost of manufacture for 1934, including interest, sinking fund, and depreciation charges, was $1.5495 against $1.6414 for 1933, a decrease of $0.0919. The amount of gas used for public lighting was 151,225,691 cu.ft., equal to 52·7% of the output. During the year 46 new lamps were erected and 3 cut off. The total number of lamps on the district is 3,871, of which 1,140 are fitted with clock controllers for automatic lighting. 608 clock controllers were fitted during the year. The amount of gas sold to private consumers was 118,406,682 cu.ft. against 112,554,740 cu.ft. during 1933, an increase of 5·2%. The gas unaccounted for was equal to 4·4% of the make against 4.0% for 1933. 3,738 yd. of mains were laid, while 1,698 yd. were replaced. The net profit from fittings and stores was $2,939·98 against $447·10 in 1933. The revenue from hired appliances was $42,866.88 against $39,790.72 in 1933, an increase of $3,076.16. The gross profit made by the Department allowing for public lighting at cost was $283,729.69 and after deducting interest on loans, sinking fund, and depreciation charges, there was a net profit of $107,267.86 of which $25,450.53 was expended on additions of a capital nature to mains, &c., leaving a credit balance of $81,817.33. The net profit for 1933 was $93,464.79.

Wallasey.

The abstract of accounts for the year ended March 31, 1935, published by the County Borough of Wallasey shows that the revenue from the Corporation Gas Department is £190,845, as against £185,895 for the year 1933-4, this being the highest figure since 1930. The gross profit for the year is £84,668, as compared with £83,938 last year, and the net profit, after making provision for loan charges, income-tax, &c., is £7,894, again the highest figure since 1930. During this year £8,343 has been expended for the provision of new mains and services, meters, and modern gas cookers, and £22,509 in the extension and modernization of the No. 2 vertical retort installation, complete with breeze burning producers and waste-heat and producer fired boilers. New experimental plant has also been installed for the production and supply of compressed coal gas, and the five motor vehicles owned by the Gas Department are now working on coal gas instead of petrol as previously. The table of working results shows that gas used for public lighting has increased to the record figure of 88¼ million cu.ft., for which service an income of £8,500 has been obtained from the 3,500 lamps, and the scheme of conversion of all old type lanterns to modern globes is in progress. The five showrooms and Development Centres have done record business during the year in which 1,834 all-enamel cookers have been fixed, together with 550 fires, 230 water heaters, and 370 wash boilers and machines to an approximate value of £25,000.

[*Further Undertakings' Results will be found on p.* 586.]

METROPOLITAN GAS METERS, LTD.

THE MAKERS OF "METERS OF MERIT,"

BEG TO ANNOUNCE THAT

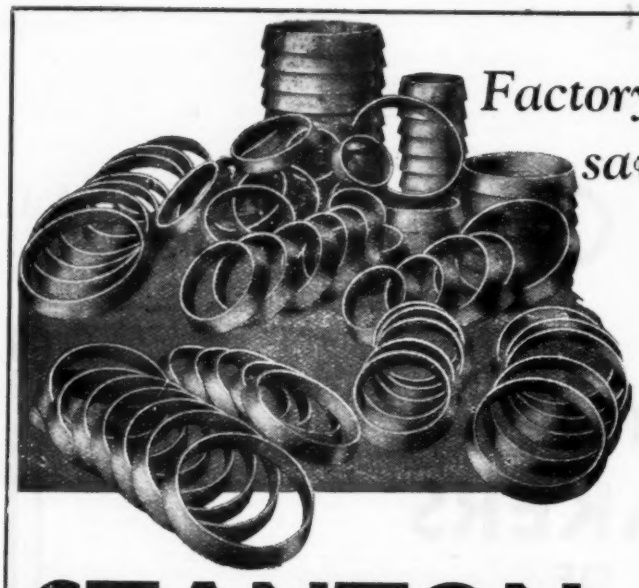
in order to provide a **LEATHER DIAPHRAGM SUSPENSION** entirely **FREE FROM METALLIC CONTACT,** they are introducing **BAKELITE** into their meter construction.

This new feature, by eliminating the risk of the destructive action which results from corrosion, will help **PROLONG THE LIFE OF THE DIAPHRAGMS.**

With the Bakelite Diaphragm Unit there is being employed **A SILENT CONTROLLING DEVICE.**

[PATENT APPLICATIONS Nos. 11746/35 AND 8722/34 HAVE BEEN MADE IN CONNECTION WITH THE DIAPHRAGM UNIT AND CONTROLLING DEVICE RESPECTIVELY]

SAMPLE S.H.C. 100 CU. FT. PER HOUR METERS WILL BE AVAILABLE SHORTLY



Factory-made Lead Rings save time in the Trench!

More easily handled than molten lead, a pre-cast lead ring also makes a more efficient lead joint. To assemble the Stanton Mechanical Lead Joint, a factory-made lead ring is pushed over the pipe spigot, and two half-collars are placed into position. The operation is then completed by the tightening of four cast-iron setscrews—no caulking is necessary.

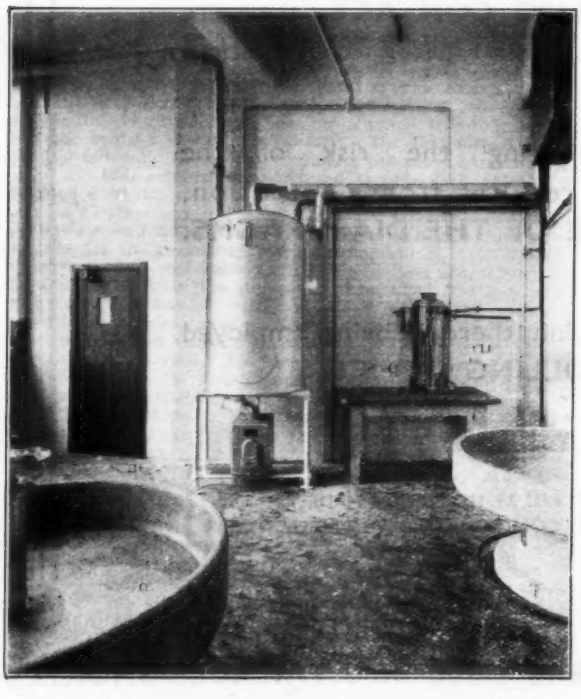
Embodied in the lead ring is a steel spring insertion ring which distributes the pressure so that the joint is effective throughout the full depth. The ring is positively held in position and cannot shrink, loosen or be displaced by "drawing" of the spigot.

Patent No. 404955, other patents pending

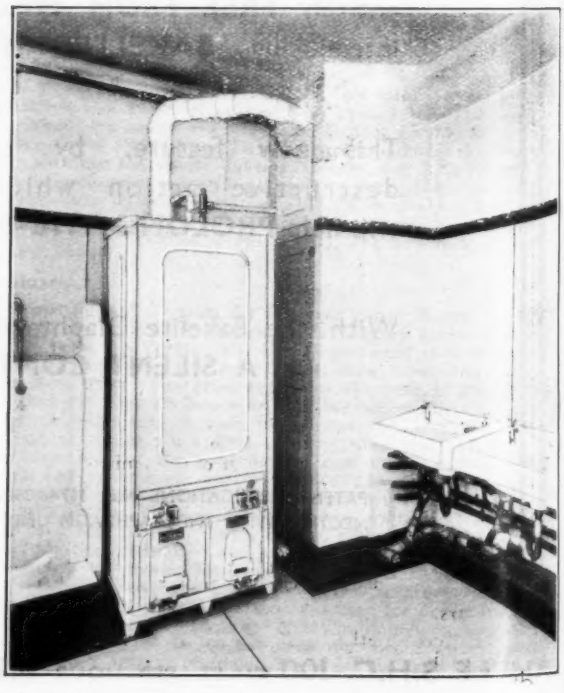
STANTON MECHANICAL LEAD JOINT

The Stanton Ironworks Company Limited, Near Nottingham

"EMPEROR" Thermal Storage Apparatus for Industrial Purposes.



Single-Unit Lagged Storage Set supplying Three Bradley Wash-Fountains in Printing Works. Capacity 200 gallons.



Twin Unit Thermal Storage Apparatus supplying Ranges of Hand Basins in the Staff Lavatories. Capacity 200 gallons.

The above photographs show two out of seven Gas-fired Hot-Water Installations for the Lavatory, Culinary and Cleaners' supplies at the Headquarters of the Iliffe and Cornwall Press, London, S.E. 1.

FULLY AUTOMATIC. *CATALOGUE ON REQUEST.* *LOW COST IN MAINTENANCE.*

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Incorporation of Rubber with Tar Products

by
D. D. PRATT
and
R. HANDLEY

A description of experiments carried out by the Authors under the supervision of Prof. G. T. Morgan, F.R.S., at the Chemical Research Laboratory, Teddington, on the incorporation of rubber with tars. We are indebted to the Rubber Growers' Association for permission to reproduce the article from their *Bulletin*.

The production of tar in Great Britain amounts approximately to 2,000,000 tons or 450,000,000 gallons annually, and of this quantity more than 50% finds application in road construction and road surfacing. It is, therefore, of the utmost importance that all possible methods of improving this British-made material should be explored, and the following experiments on the incorporation of rubber with tars were undertaken primarily for this object, but in the course of these investigations the results suggest other applications of intermediate products.

Types of Tars.

Coke oven tar is produced when coal is carbonized at 1,450° C. for the manufacture of metallurgical coke, the gas evolved during the process being of secondary importance as compared with the solid fuel.

Horizontal Retort Tar.—Owing to this mode of carbonization at 1,300° to 1,400° C., the tar produced has long been known as horizontal retort tar, but more recently it has been referred to as high aromatic tar owing to the presence of certain typical constituents.

Vertical Retort Tar.—The tars produced from coal carbonized in this type of retort differ fundamentally from horizontal retort tar. These vertical retort tars are produced at a maximum temperature of 1,000°-1,200° C. but much of the coal is carbonized at an appreciably lower temperature owing to the cooling effect of steam and other escaping gases. Hence these tars possess some of the characteristics of true low-temperature tars.

Low-Temperature Tar.—Low-temperature carbonization is a comparatively recent development in the utilization of coal and is carried out for the production of solid smokeless fuel. During this carbonization, temperatures round about 600° C. are employed and the tar produced is mainly of a novel character.

Characteristics of Tars.

For the purposes of this Paper it will be sufficient to summarize the salient features of the four types of tars already mentioned. Coke-oven and horizontal retort tars are very similar in composition and consist essentially of from 50 to 60% of highly polymerized, resinous material dissolved in oils of aromatic nature and containing small percentages of phenols, such as carbolic acid and the cresols, and bases such as pyridine. The neutral oils consist of the well-known aromatic hydrocarbons, benzene, toluene, naphthalene, and anthracene, together with their homologues. At the other end of the scale low-temperature tars, which are low aromatic tars, contain only about 20% of resinous material dissolved in oils of a paraffinoid and hydrogenated nature containing a large percentage, often amounting to 25% of the tar, of phenolic compounds. Aromatic constituents such as naphthalene and anthracene which are characteristic of high-temperature tars occur only in traces.

Produced at temperatures intermediate between high-temperature and low-temperature carbonization vertical retort tars display characteristics of both horizontal and low-temperature tars. Thus, the resinoid content which is less polymerized than in the high-temperature tar is about 50% but the phenolic portion approximates to that of a low-temperature tar, while the neutral oils contain both aromatic and paraffinoid constituents.

Road Tars.

Two general methods are in operation for the preparation of refined tars for road work: (1) Distillation or "topping" of the crude tar to a predetermined temperature to remove volatile oils, phenols, and naphthalene leaving a residual tar of the required viscosity. (2) Distillation of crude tar to 360° leaving a residue of pitch which is subsequently "oiled back" with a prepared neutral oil to furnish a tar of the required viscosity.

Method 1 is employed chiefly in the case of coke-oven and horizontal retort tars, since they contain only a small percentage of phenols which are almost wholly removed by "topping." As phenolic content is rigidly restricted in road tar specifications, vertical retort tars are refined by Method 2, the prepared oil being washed with aqueous caustic soda to reduce substantially the percentage of phenols. Up to the present time low-temperature tars as such have not been applied to the roads but if and when this use is made of them they will be probably prepared by Method 2.

Tar Distillates.

When high-temperature tars are distilled, a fraction rich in naphthalene occurs between 200° and 230° C. From 230° to 300° a distillate known as dead oil is collected, and from 300° to 360° the well-known anthracene fraction (green grease) distils over. This oil yields a crystalline deposit which is filtered and drained and is known as anthracene cake, the oily filtrate being marketed as anthracene oil. Anthracene oil is, therefore, a saturated solution of anthracene and related crystalline hydrocarbons in other constituents of an oily nature. At 360° the distillation is complete and the residue in the still, amounting to over 50% of the crude tar, is run out hot and forms tar pitch which, therefore, consists of the undistillable resinoids of the tar after treatment at 360° C.

Corresponding distillates from vertical retort and low-temperature tars do not show the same characteristics as the aforementioned fractions from high-temperature tars. There is no deposition of solid aromatic hydrocarbons from low-temperature tars, although in the least volatile fraction waxy constituents separate out. To prepare neutral oils from these tars selected fractions are washed successively with aqueous caustic soda and mineral acid to remove phenolic and basic constituents respectively.

Experimental.

It was known that rubber was not compatible with high-temperature tars and that although anthracene oil dissolves rubber, addition of pitch to such a solution caused immediate separation of the rubber. The problem, therefore, appeared to be that of developing a stabilizing medium for anthracene oil—rubber-pitch complexes. It was considered preferable, however, in the first place to collect further data on the behaviour of oils and pitches from other types of tar and to compare the relative solvent powers of comparable fractions from low-temperature "vertical" and "horizontal" tars.

Incorporation of Rubber with Neutral Oils.

A fraction of oil distilling between 300° and 360° was prepared from each type of tar, filtered if necessary from crystalline deposit and dephenolated by washing with aqueous caustic soda. When these oils were milled with crepe rubber the 20/80 oil-rubber incorporations formed were readily diluted to any desired concentration by heating at 100° with fresh additions of oil. The solutions so obtained were clear, stable, and homogeneous when examined microscopically. It was observed in these experiments that of the three oils the low-temperature tar product most readily incorporated with rubber.

Since milling operations are slow and costly an alternative method of introducing rubber into tar oils was developed by the use of the Hurrell Homogeniser. Tar oils passed through this apparatus together with unvulcanized 40 or 60% latex rise to opaque viscous emulsions which, on heating to 120° C. for 20 hours, were converted into clear homogeneous solutions comparable with those obtained by milling and dilution.

Prolonged heating at 120° may be dispensed with by further application of the homogeniser, for if the first formed emulsions are passed from 8 to 10 times through this apparatus at 100° during a period not exceeding 10 to 15 minutes, the product becomes increasingly clarified with a corresponding decrease in viscosity, and the final product is comparable with those obtained either by milling experi-

ments or by 20 hours' heating of the emulsion in open vessels.

The amount of rubber which can be introduced in one run through the homogeniser varies with the type of oil. Low-temperature tar oil can absorb 7 to 8% of its weight of rubber whereas 5% is the maximum for anthracene oil. The final clear limpid solutions, however, can be utilized as fresh starting material, and solutions containing up to 20% of rubber can thus be concentrated.

Many incorporations of tar oils and rubber have been carried out on various fractions of both low-temperature and vertical retort tar oils, and in all cases clear, stable solutions were obtained. Commercial anthracene oil from high-temperature tar is also a suitable medium, but care must be exercised in the selection of this oil as on one occasion a very heavy oil distilling between 330° and 360° failed to give a satisfactory emulsion.

Parallel experiments on the introduction of vulcanized rubber into tar oils were carried out employing a vulcanized latex (Vultex). Emulsions were readily formed with all three types of oil and on heating or, preferably, on repeated passage through the homogeniser, they were clarified to clear, stable gels which on filtration were separated into the original oil as filtrate and a concentrated gel or paste.

Addition of Pitches to Rubber Solutions.

The aforementioned rubber solutions were employed in experiments on the effect of adding pitches to rubber. It was confirmed that pitch readily causes deposition of rubber from solution in anthracene oil but this point is not reached until the concentration of pitch amounts to about 8% of the mixture.

When the corresponding tar pitches were added to solutions of rubber in vertical retort or low-temperature tar oils no separation of rubber took place, and this result was independent of the concentration of either pitch or rubber. The stability of these oils-rubber-pitch complexes cannot be ascribed to any differences in the pitch as compared with high-temperature tar pitch since it was proved experimentally that whereas low-temperature tar pitch did cause deposition of rubber from solution in anthracene oil, high-temperature tar pitch formed a stable mixture with rubber in low-temperature oils.

The explanation of the stability of low-temperature and vertical retort tar oils in conjunction with rubber and pitch must, therefore, lie in the different chemical nature of these oils as compared with anthracene oil. It has already been mentioned that anthracene oil is a saturated solution of complex solid hydrocarbons and it is conceivable that these crystalline compounds exert a "salting out" effect when pitch is added to the rubber solution. To test this hypothesis, a comparable fraction of low-temperature tar boiling between 300° and 360° and containing only a negligible amount of solid hydrocarbons, was treated with "anthracene cake" derived from a high-temperature tar. The concentrated solution so obtained yielded a satisfactory solution with rubber but on the addition of pitch the rubber was thrown out of solution although not to so marked an extent as when anthracene oil was used as solvent. It would appear, therefore, that although the crystalline constituents present in anthracene oil do play an important part in the stability of rubber and pitch in that oil, yet the paraffinoid oils of low-temperature tar form a better medium than the wholly aromatic oils of high-temperature tar. Table I. shows that low-temperature oils saturated with anthracene are compatible with rubber in the presence of about 30% pitch whereas it has been shown that anthracene oil can only dissolve 8% of pitch before the rubber is deposited.

TABLE I.—*"Salting Out" Effect of Anthracene Cake.*

% Composition of Final Product.				Results.
Low Temp. Tar Oils.	Anthracene Cake.	Rubber.	Pitch.	
43·0	..	2·3	54·7	Stable, homogeneous mixture
40·0	20·0	2·0	38·0	,, ,, ,,
42·7	25·0	2·3	30·0	,, ,, ,,
38·0	30·0	2·0	30·0	Surface separation
36·3	27·3	9·0	27·3	Complete separation

No fraction of horizontal retort tar has been found to yield complexes of oil, rubber, and pitch so satisfactorily as oils from low-temperature or vertical retort tars, but a considerable degree of stability is attainable by selection of suitable fractions. For example, dead oil, the fraction distilling between 230° and 300° which is not so highly saturated as anthracene oil, readily dissolved rubber and yielded stable complexes containing up to 30% of pitch. Moreover, on employing an oil distilling between 160° and 175° C. stable complexes containing up to 50% of pitch were obtained. These results are summarized in Tables II. and III.

TABLE II.—*Stability of Dead Oil—Rubber—Horizontal Retort Tar Pitch.*

5% Rubber Solution in Dead Oil B.P. 230°–300° C. (Gms.).	Horizontal Retort Tar Pitch (Gms.).	% Composition of Final Product.			Results.
		Rubber.	Oils.	Pitch.	
150	17	4·5	85·3	10·1	Stable mixture
150	27	4·2	80 5	15·2	,, ,,
150	40	3·9	75·0	21·0	,, ,,
150	50	3 7	71·2	25·0	,, ,,
150	70	3·4	64·7	31·8	Slow coagulation

TABLE III.—*Stability of Horizontal Retort Tar Oils B.P. 160°–175°—Rubber—Pitch.*

H.R.T. Oils B.P. 160 – 175° C. (Gms.).	Rubber (Gms.).	H.R.T. Pitch (Gms.).	% Composition of Final Product.			Results.
			H R.T. Oils.	Rubber.	Pitch.	
470·0	20·0	54·0	86·3	3·6	10·0	Stable mixture
440·0	18·5	115·0	76·7	3·2	20·0	,, ,,
380·0	16·0	168·0	67·3	2·8	29·8	,, ,,
310·0	13·0	216·0	57·5	2·4	40·1	,, ,,
252·0	10·5	262·5	48·0	2·0	50·0	,, ,,
212·5	8·5	256·0	44·5	1·8	53·6	Slow coagulation

It is evident, therefore, that by the selection of oils substantially free from crystalline material, stable oil-rubber-pitch complexes can be constituted from high-temperature tar products but since in practice road tars derived from horizontal tar contain a large proportion of anthracene oil a stabilizing diluent must be added. The foregoing experiments suggest that low-temperature tar oil would prove a suitable medium and the summarized results of Table IV. are confirmatory.

TABLE IV.—*Stabilizing Effect of Low-Temperature Tar Oil on Horizontal Retort Tar and Rubber.*

(*a*) Containing 1% Rubber.

20 Sec. Viscosity H.R. Tar (Gms.).	Rubber (Gms.).	Low-Temp. Oils (Gms.).	% Composition of Final Product.			Results.
			Horizontal Tar.	Rubber.	L.-T.T. Oils.	
25·0	0·5	24·5	50	1	49	Stable mixture
37·5	0·5	12·0	75	1	24	,, ,,
40·0	0·5	9·5	80	1	19	,, ,,
45·0	0·5	4·5	90	1	9	Slow coagulation
Blank with Rubber Solution in Anthracene Oil Addition						
40·0	0·5	9·5	80	1	19	Immediate coagulation while hot

(*b*) Containing 2% Rubber.

20 Sec. Viscosity H.R. Tar (Gms.).	Rubber (Gms.).	Low-Temp. Oils (Gms.).	% Composition of Final Product.			Results.
			Horizontal Tar.	Rubber.	L.-T.T. Oils.	
25·0	1·0	24·0	50	2	48	Stable mixture
30·0	1·0	19·0	60	2	38	,, ,,
40·0	1·0	9·0	80	2	18	Slow coagulation, after standing 10 days

(*c*) Containing 3% Rubber.

20 Sec. Viscosity H.R. Tar (Gms.).	Rubber (Gms.).	Low-Temp. Oils (Gms.).	% Composition of Final Product.			Results.
			Horizontal Tar.	Rubber.	L.-T.T. Oils.	
12·5	1·5	36·0	25	3	72·0	Stable mixture
20·0	1·5	28·5	40	3	57·0	,, ,,
35·0	1·5	13·5	70	3	27·0	Unstable; coagulation developed slowly

It is possible, however, that the addition of low-temperature oils would not commend itself to those engaged on high-temperature tars as the addition of this oil would certainly affect the tar in other directions notably in drying properties. Since certain fractions of horizontal retort tar do, however, give a considerable measure of stability in

combination with rubber and pitch the stabilizing effect of adding selected horizontal retort tar oils was investigated with the results shown in Table V.

TABLE V.—*Stabilizing Effect of Volatile Horizontal Retort Tar Oils on Horizontal Tar and Rubber.*

% Composition of Final Product.			Results.
20 Sec. Horizontal Retort Tar.	Rubber.	Horizontal Retort Oils. B.P. 160-175.	
50	1	49	Stable mixture
75	1	24	" "
80	1	19	Separation
50	2	48	Stable mixture
60	2	38	" "
80	2	18	Coagulation on cooling
25	3	72	Stable mixture
40	3	57	" "
70	3	27	Coagulation on cooling

Addition of Pitch to Gels.

When pitches were added to the gels obtained from vulcanized latex and neutral oils no separation of rubber occurred in any of the three cases; stable mixtures of oil, rubber, and pitch were obtained even in the case of anthracene oil. The introduction, therefore, of vulcanized rubber into tars is a simple matter consisting of the compounding of the tar with vulcanized latex. Alternatively the concentrated gel previously described can be stirred directly into the tars.

Pitch and Rubber.

The experiments described on the incorporation of rubber into tar oils with or without the addition of pitch suggest a readily available method whereby pitch-rubber complexes may be produced. Since the possibility of direct introduction of rubber into pitch by the use of the homogenizer is limited by the fact that even a small addition of rubber renders the pitch so tough that difficulties arise in the manipulation of the apparatus, use has been made of volatile oils as a "carrying medium." A series of pitch-rubber complexes has been prepared containing from 10 up to 90% of rubber by the following general method.

Unvulcanized 60% latex was homogenized with neutral low-temperature tar oil b.p. 100°-180° C. and a clear solution containing 16·0% rubber formed by the methods already described. To weighed portions of this solution pitch was added up to the desired concentration, dissolved by warming at 80° and the mixture again homogenized. The volatile oils were then removed either by vacuum or steam distillation leaving the rubber-pitch component.

As might be expected such components exhibit increasing toughness with increase of rubber content and are promising starting materials for further experiment.

Summary and Conclusions.

(1) Vulcanized or unvulcanized rubber is readily introduced into low-temperature or vertical retort tars previously dephenolated either by (*a*) dissolving the rubber in selected oils and adding the desired proportion of pitch or by (*b*) homogenizing the prepared tar direct with latex, with subsequent removal of water.

(2) Vulcanized rubber is compatible with horizontal retort tar but to prepare a complex consisting of this tar and unvulcanized rubber, a diluent must be added. Low-temperature tar oil is a suitable medium as are to a lesser degree horizontal retort tar oils previously freed from crystalline material.

(3) Rubber can be incorporated into any pitch by the use of a volatile tar oil (preferably low-temperature tar oil) which dissolves both rubber and pitch and can be removed by steam distillation.

Samples of the various products described in this Paper are now under examination particularly for viscosity-temperature relationships, and it is proposed to submit them for other tests as road materials.

Richmonds' New Season's List.

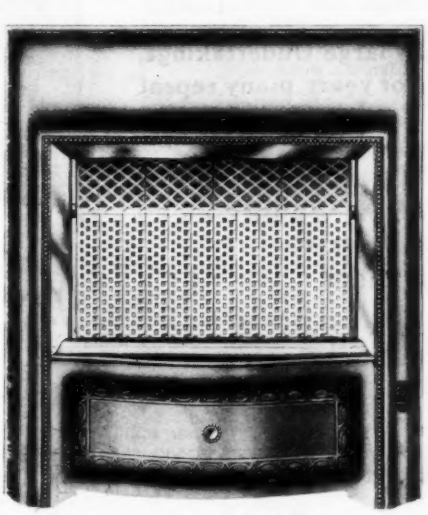
All who are interested in the development and marketing of gas fires will welcome the new season's list just published by Richmonds Gas Stove Company, Ltd. (Radiation Ltd.). This attractive publication is devoted entirely to Radiation High "Beam" fires and shows examples of their popular coloured finishes. Particular interest will be centred round their several new designs of which the following is a brief *résumé:*

The new "Cloister" High "Beam" model is a departure from previous designs in that the fire front is raised to about 9½ in. from the floor level. Thus, although the "Cloister" stands upon the hearth the elevated position of the fire front tends to give to it the features of a built-in fire. The "Cloister" is fitted with chromium-plated reflectors which surround the radiants and these not only convey the impression of a wider and taller fire front but also add much to the pleasing and modern appearance of the fire. The "Cloister" is also supplied in colour finishes without chromium-plated reflector and is then known as the "Cloister II."

All these High "Beam" fires are equipped with the special Radiation features including the patent self-lighting tap and full fire front. The "Cloister" and "Cloister II." are made in 6, 7, and 9 radiant sizes, the large size being fitted with either simplex burner and tap or duplex type which allows the centre portion only or the whole fire front to be used as required. These and all other Richmond High "Beam" models are available in a multiplicity of "Lustre" and coloured paint finishes.

The "Georgian" is another new High "Beam" fire of Richmond design and is specially suitable for large rooms. This fire is made only in a 12-radiant size with duplex burner and tap and is both powerful and impressive. The "Keble" is also a High "Beam" fire of new design. Its special feature is its round top which is designed to conform with round fireplace openings.

A new Richmond Lustre finish—No. 7, Burr Brown—makes its first appearance in the new season's range.



The "Georgian" High "Beam" Fire.

Developing Existing Designs.

The "Reflector" High "Beam" fire was introduced last season in 7 and 9 radiant sizes. A 6-radiant size has now been added to the series. In addition, there is now a companion fire known as the "Reflector II.," in which the reflectors which surround the fire front are not chromium-plated (as in the "Reflector" model) but are finished in the same colour as the rest of the fire.

The "Castile" is another of the High "Beam" fires which established itself last season in 6, 7, and 9 radiant and a 5-radiant size has now been added to complete the series. It will be recalled that the "Castile" is also available in a special series of 6, 7, and 9 radiant sizes in which all have a uniform overall height of 24 in., being so proportioned as to fit exactly into many of the modern tiled surrounds which are now so popular.

The "Flambeau" and "Westminster" fires (the latter being Richmonds attractive built-in pattern) complete Richmonds series of High "Beam" designs which will make a ready appeal to the public through display in showroom windows backed by the Radiation advertising schemes in the national and local Press and in the home magazines. We understand that supplies of the new catalogue, which gives full specifications and prices of the various models, are now available.

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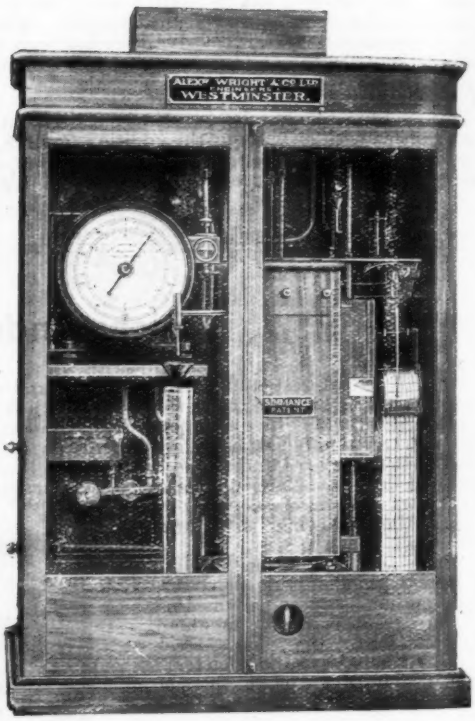

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Gas Markets and Manufactures

Stock Market Report

(For Stock and Share List, see later page)

Notwithstanding the doubts which still exist as to the ultimate trend of international events, it is satisfactory to note that markets generally are continuing very steady. There remains naturally a general disinclination to open fresh commitments which seriously curtails the volume of business, and this was particularly the case throughout the greater part of last week. Towards the close, however, a stronger tone developed, and with the aid of bargain hunters prices began to move up. British Funds, together with a number of leading industrial shares, more than recovered their previous losses, and the home rail market also improved. It is evident that a great deal of money is awaiting employment, and when the situation clears a change over to active conditions with rising prices will quickly follow.

The support for Gas stocks and shares was a trifle heavier than the previous week though the general tendency was towards a weakening of prices, especially among the leading ordinary stocks. Those of the three Metropolitan Companies were all marked down, Gas Light units falling 6d. to 27s. 6d.; South Metropolitan 2 to 129½, and Commercial dropping 1 to 102½, while Imperial Continental also fell 1 to 211½. The one bright spot was a sharp rise of 6 in Brighton 5% to 158½, business being done at 161, at which price the yield, on the basis of a 6¾% dividend, works out at £4 3s. 10d.%. It will be noticed that Tottenham ordinary, on which is distributed a similar rate of dividend as that on the Brighton 5% stock, changed hands at 150 only, giving a return of £4 10s.%, so that some further appreciation in the latter stock appears justified. With regard to the Metropolitan Companies, the differences in the yields obtainable on the three stocks, as shown below, are remarkable, for while it is true that a small reduction in the annual distribution was made last year in the case of both the Commercial and South Metropolitan companies, the current prices of the latter two Companies' stocks are particularly low, especially that of the Commercial, and purchases are well worth consideration:

—	Quotations.		Dividend 1934.	Yield on Current Middle Price.
	Sept. 7, 1934.	Sept. 6, 1935.		
			%	£ s. d.
Gas Light Units .	26s. 6d.—27s.	27s.—28s.	£5 12s.	4 1 5
South Metropolitan	135—138	127—132	5¾	4 8 9
Commercial . .	118—123	100—105	5½	5 7 3

Current Sales of Gas Products

The London Market for Tar Products.

Sept. 9.

There are no alterations to record in the prices of tar products, which are as follows:

Pitch, 33s. to 34s. per ton f.o.b.

Creosote, about 6d. per gallon.

Refined tar, 4d. per gallon in bulk at makers' works.

Pure toluole, 2s. 2d. to 2s. 3d.; pure benzole, 1s. 7d. to 1s. 8d.; 95/160 solvent naphtha, 1s. 5d.; and 90/160 pyridine, about 4s. 6d. to 4s. 9d.—all per gallon naked at makers' works.

Tar Products in the Provinces.

Sept. 9.

The average prices of gas-works products during the week were: Gas-works tar, 18s. to 23s. Pitch—East Coast, 31s. to 33s. f.o.b. West Coast—Manchester, Liverpool, Clyde, 31s. to 33s.* Toluole, naked, North, 1s. 8d. to 1s. 9d. Coal-tar crude naphtha, in bulk, North, 6¾d. to 7d. Solvent naphtha, naked, North, 1s. 5d. to 1s. 5½d. Heavy naphtha, North, 9½d. to 10½d. Creosote, *ex* works, in bulk, North, liquid and salty, 5¼d. to 5½d.; low gravity, 5d. to 5⅛d.; Scotland, 5d. to 5¼d. Heavy oils, in bulk, North, 5d. to 5½d. Carbolic acid, 60's, 1s. 11d. to 2s. Naphthalene, £10 to £11. Salts, 60s. to 75s., bags included. Anthracene, "A" quality, 2½d. to 3d. per minimum 40%, purely nominal; "B" quality, unsalable.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port it will be necessary to deduct the loading costs and the tolls whatever they may be.

Tar Products in Scotland.

GLASGOW, Sept. 7.

As is usual at this time of the year more business is being conducted. In the meantime prices show no material alteration.

Crude gas-works tar.—The actual value is 26s. to 28s. per ton *ex* works in bulk.

Pitch is still without interest at 30s. per ton f.o.b. Glasgow for export, and 30s. per ton *ex* works in bulk for home trade.

Refined tar is still quoted at 2¾d. per gallon f.o.r. in buyers' packages. This was mentioned in error last week at 2d. per gallon.

Creosote Oil.—Production is well looked after and prices continue steady. B.E.S.A. Specification, 5⅛d. to 5⅜d. per gallon; low gravity, 5¼d. to 5½d. per gallon; and neutral oil, 5¼d. to 5½d. per gallon; all f.o.r. in bulk.

Cresylic acid is receiving more attention, but competition continues extremely keen and values are easy. Pale, 97/99%, 1s. 1½d. to 1s. 2½d. per gallon; dark, 97/99%, 1s. to 1s. 0½d. per gallon; and pale, 99/100%, 1s. 2½d. to 1s. 3½d. per gallon; all *ex* works naked.

Crude naphtha.—This is still valued at 4½d. to 5d. per gallon f.o.r., according to quality and district.

Solvent naphtha.—90/160 grade is 1s. 3½d. to 1s. 4d. per gallon, and 90/190 heavy naphtha is 10d. to 11d. per gallon.

Motor benzole is quoted in small quantities at 1s. 3½d. to 1s. 4d. per gallon in bulk at makers' works.

Pyridines.—90/160 grade is 5s. 6d. to 6s. per gallon, and 90/140 grade 6s. to 6s. 6d. per gallon.

Benzole Prices.

These are considered to be the market prices for benzole at the present time:

	s. d.		s. d.	
Crude benzole	0 9½	to	0 10	per gallon at works
Motor ,, ...	1 3	,,	1 3½	,, ,, ,,
90% ,, ...	1 4	,,	1 4½	,, ,, ,,
Pure ,, ...	1 7½	,,	1 8	,, ,, ,,

Contracts Advertised To-Day

Boiler (Waste Heat).

Hinckley Gas Department. [p. 590.]

Condensers.

Salford Corporation. [p. 590.]

Neutralizing Apparatus for S/A Plant.

Salford Corporation. [p. 590.]

Pipes and Specials.

Blackpool Gas Department. [p. 590.]
Leeds Gas Department. [p. 590.]

Overseas Opportunities

Cape Town.

H.M. Trade Commissioner at Cape Town reports that the Bellville (Cape Province) Village Management Board are calling for tenders, to be presented in Bellville by Sept. 25, 1935, for the supply of cast-iron pipes, special castings, valves, &c. (Ref. T.Y. 5,233.)

Further Gas Undertakings' Results

Stafford.

The accounts of the Stafford Gas Department for the year ended March 31, 1935, show that the sales of gas totalled 318,609,700 cu.ft. The average price per 1,000 cu.ft. sold was 3s. 4·297d., and the income from this source amounted to £53,496. Receipts from residuals realized £9,165. Of this amount coke accounted for £7,053 and tar £2,762, less sulphate of ammonia, £650. Net profit on fittings was £981. The net revenue account shows a gross profit of £17,669, and a net profit of £5,924, which was carried to the appropriation account. The coal carbonized and coal equivalent of oil and coke used in the manufacture of carburetted water gas was 17,581 tons, and the gas made totalled 341,387,000 cu.ft. The gas make per ton of coal was 19,418 cu.ft.

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STOCK AND SHARE LIST

Official Quotations on the London and Provincial Stock Exchanges

Issue. £	Share	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations, Sept. 6.	Rise or Fall on Week.	Transactions, Lowest and Highest Prices During the Week.
1,551,868	Stk.	Mar. 11	7	7	Alliance & Dublin Ord. ...	132—142	...	141½
374,000	,,	June 24	4	4	Do. 4 p.c. Deb. ...	90—100	...	...
557,655	,,	Aug. 12	7	7	Barnet Ord. 7 p.c.	165—170	...	...
300,000	1	Apl. 8	1/4½	1/9½	Bombay, Ltd.	1½—1⅝	...	29/—30/-
178,480	Stk.	Aug. 12	9½	9½	Bournemouth sliding scale ...	222—232	...	...
550,050	,,	,,	7	7	Do. 7 p.c. max. ...	168—173	...	...
489,160	,,	,,	6	6	Do. 6 p.c. Pref. ...	147—152	...	150½
50,000	,,	June 24	3	3	Do. 3 p.c. Deb. ...	85—90	...	...
262,025	,,	,,	4	4	Do. 4 p.c. Deb. ...	106—111	...	...
335,000	,,	,,	5	5	Do. 5 p.c. Deb. ...	123—128	...	125
357,900	,,	Aug. 12	7½	7½	Brighton, &c., 6 p.c. Con. ...	170—175	...	...
649,955	,,	,,	6¾	6¾	Do. 5 p.c. Con. ...	156—161	+6	161
205,500	,,	,,	6	6	Do. 6 p.c. B. Pref.	142—147	...	...
1,487,500	,,	July 8	5	5	Bristol, 5 p.c. max.	120—122*a*	...	...
120,420	,,	June 7	4	4	Do. 1st 4 p.c. Deb. ...	102—104*a*	...	...
217,870	,,	,,	4	4	Do. 2nd 4 p.c. Deb. ...	101—103*a*	...	...
328,790	,,	,,	5	5	Do. 5 p.c. Deb.	127—130*a*	...	...
855,000	,,	Mar. 11	7	8	British Ord.	154—159	...	158—158½
100,000	,,	June 7	7	7	Do. 7 p.c. Pref.	160—165	...	160½—161
350,000	,,	,,	5½	5½	Do. 5½ p.c. "B" Cum. Pref.	112—117	...	...
120,000	,,	,,	4	4	Do. 4 p.c. Red. Deb. ...	95—100	...	...
450,000	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	109—114	...	...
200,000	,,	,,	...	17/6⅝	Do. 3½ p.c. Red. Deb. ...	99—101	...	...
100,000	10	22 May '33	6	4	Cape Town, Ltd.	1—3	...	...
100,000	10	6 Nov.'33	4½	4½	Do. 4½ p.c. Pref. ...	1—3	...	...
150,000	Stk.	June 24	4½	4½	Do. 4½ p.c. Deb. ...	83—88	...	...
626,860	,,	July 22	6	6	Cardiff Con. Ord.	127—132	...	...
237,860	,,	June 7	5	5	Do. 5 p.c. Red. Deb.	107—112	...	...
157,150	,,	Aug. 12	6½	5	Chester 5 p.c. Ord.	109—114*b*	...	...
98,936	1	Mar. 25	2/-	2/-	Colombo, Ltd., Ord.	1⅜—1⅝	...	...
24,500	1	,,	1/4½	1/4½	Do. 7 p.c. Pref. ...	20/6—22/6	...	...
609,204	1	Mar. 25	-/11·48	-/11·48	Colonial Gas Assn. Ltd. Ord.	20/6—22/6	...	21/1½—21/6
296,053	1	,,	1/3·30	1/3·30	Do. 8 p.c. Pref.	26/—28/-	...	25/9—26/3
1,775,005	Stk	Aug. 12	6	5	Commercial Ord.	100—105	−1	100—103¾
620,000	,,	June 7	3	3	Do. 3 p.c. Deb. ...	87—92	...	...
286,344	,,	Aug. 12	5	5	Do. 5 p.c. Deb. ...	121—126	...	124
807,560	,,	Aug. 12	7	7	Croydon sliding scale... ...	152—157	...	154½
569,590	,,	,,	5	5	Do. max. div.	113—118	...	...
620,385	,,	June 24	5	5	Do. 5 p.c. Deb.	123—128	...	...
542,270	,,	Aug. 12	10	7	Derby Con.	180—190*c*	...	...
55,000	,,	June 24	4	4	Do. 4 p.c. Deb.	100—105*c*	...	...
239,000	,,	Aug. 12	5	5	East Hull Ord. 5 p.c.	106—111	...	...
181,625	,,	Aug. 12	6	6	East Surrey Ord 5 p.c. ...	129—134	...	...
175,609	,,	June 7	5	5	Do. 5 p.c. Deb. ...	123—128	...	...
19,313,481	,,	Aug. 12	5⅝	5⅝	Gas Light & Coke 4 p.c. Ord.	27/—28/-*f*	−·/6	27/—27/10½
2,600,000	,,	,,	3½	3½	Do. 3½ p.c. max.	89—92	−1	90½—91½
4,477,106	,,	,,	4	4	Do. 4 p.c. Con. Pref. ...	108—111	...	109—110
8,602,497	,,	June 7	3	3	Do. 3 p.c. Con. Deb. ...	91—94	...	92½—93½
3,642,770	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	115—118	...	117—118
3,500,000	,,	,,	4½	4½	Do. 4½ p.c. Red. Deb. ...	113—116	...	‡114½—116
270,466	,,	Aug. 12	6	6	Harrogate New Cons. ...	132—137	...	...
140,000	1	Mar. 25	1/7½	1/7½	Hongkong & China, Ltd. ...	1½—1¾	...	...
213,200	Stk.	Aug. 12	6	6	Hornsey Con. 3½ p.c.... ...	130—135	...	...
5,600,000	,,	May 13	10	14	Imperial Continental Cap. ...	209—214	−1	210½—213½
223,130	,,	July 22	3½	3½	Do. 3½ p.c. Red. Debs.	91—96	...	...
285,242	,,	Aug. 12	8½	8½	Lea Bridge 5 p.c. Ord. ...	175—180	...	...
2,167,410	,,	Aug. 12	6	6	Liverpool 5 p.c. Ord.... ...	133—135*b*	−2	...
245,500	,,	June 7	5	5	Do. 5 p.c. Red. Pref. ...	105—110*b*	...	...
306,083	,,	July 8	4	4	Do. 4 p.c. Deb.	103—106*b*	...	...
165,736	,,	Aug. 26	10	8	Maidstone 5 p.c. Cap. ...	182—192*	...	...
63,480	,,	June 24	3	3	Do. 3 p.c. Deb. ...	82—87	...	83¾
75,000	,,	May 27	†10	†10	Malta & Mediterranean ...	212—222	...	...
392,000	—	Apl. 1	5½	5½	Metropolitan (of Melbourne) 5½ p.c. Red. Deb.	100—105	...	...
231,978	Stk.	Aug. 12	5	5	M. S. Utility "C" Cons. ...	108—113	...	...
818,657	,,	,,	4	4	Do. 4 p.c. Cons. Pref.	101—106	...	103
360,075	,,	June 24	4	4	Do. 4 p.c. Deb. ...	103—108	...	...
148,955	,,	,,	5	†5	Do. 5 p.c. Deb. ...	123—128	...	...
125,000	—	July 1	3½	3½	Do. 3½ p.c. Rd. Rg. Bds.	97—100	...	...
675,000	,,	June 24	†13	†13	Montevideo, Ltd.	48—53	...	51
2,061,315	,,	Aug. 12	5¾	5	Newcastle & Gateshead Con.	25/3—26/3*df*	...	...
682,856	,,	,,	4	4	Do. 4 p.c. Pref. ...	107—108d*	...	...
776,706	,,	June 7	3½	3½	Do. 3½ p.c. Deb. ...	100—101*d*	...	...
277,285	,,	Oct. 8	5	5	Do. 5 p.c. Deb. '43 ...	105—107*d*	...	...
274,000	,,	Aug. 12	5	5	Newport (Mon.) 5 p.c. max....	113—118*a*	...	...
225,000	,,	Aug. 12	7½	7½	North Middlesex 6 p.c. Con.	162—172	...	174—175
396,160	,,	Aug. 12	5	5	Northampton 5 p.c. max. ...	105—110	...	...
300,000	,,	Apl. 29	†9	†7	Oriental, Ltd.	168—173	...	...
416,617	,,	June 7	8	8	Plym'th & Stonehouse 5 p.c.	162—167	...	...
504,416	,,	Aug 12	8½	8½	Portsm'th Con. Stk. 4 p.c. Std.	170—175	...	...
241,446	,,	,,	5	5	Do. 5 p.c. max. ...	108—113	...	...
114,000	,,	July 22	5	5	Preston 5 p.c. Pref.	106—111	...	...
321,961	1	Apl. 8	...	...	Severn Val. Gas Cor. Ld. Ord.	22/—23/-	...	23/—23/3
319,510	1	Mar. 25	...	...	,, ,, 4½ p.c. Cum. Pref.	22/—23/-	...	...
1,736,968	Stk.	Aug. 26	6	6	Sheffield Cons.	140—142a*	...	...
95,000	,,	June 24	4	4	Do. 4 p.c. Deb.	102—104*e*	...	...
133,201	,,	Aug. 12	5	8½	Shrewsbury 5 p.c. Ord. ...	139—144	...	140—140¾
90,000	10	May 27	‡3	‡3½	South African	3—4	...	...
1,061,779	1	May 13	1/2½	1/2½	South East'n Gas Cn. Ld. Ord.	28/—29/-	...	...
845,016	1	Mar. 11	-/10½	-/10½	Do. 4½ p.c. Red. Cum. Pref.	22/6—23/6	...	...
450,000	Stk.	Aug. 12	4	4	Do. 4 p.c. Red. Deb. ...	100—103	...	...
6,709,895	,,	Aug. 12	6½	5	South Met. Ord.	127—132	−2	126½—130¾
1,135,812	,,	,,	6	6	Do. 6 p.c. Irred. Pf. ...	147—152	...	149—149½
850,000	,,	,,	4	4	Do. 4 p.c. Irred. Pf. ...	107—110	...	108
1,895,445	,,	June 24	3	3	Do. 3 p.c. Deb. ...	89—92	−1	89½—89¾
1,000,000	,,	July 8	5	5	Do. 5 p.c. Red. Deb....	114—117	−1	116—117
209,820	,,	Aug. 12	8½	8½	South Shields Con.	171—173*d*	...	...
1,543,795	,,	Aug. 12	6	6	South Suburban Ord 5 p.c. ...	128—133	...	127½
512,825	,,	,,	5	5	Do. 5 p.c. Pref. ...	121—126	...	...
500,000	,,	,,	4	4	Do. 4 p.c. Pref. ...	105—110	...	...
888,587	,,	June 7	5	5	Do. 5 p.c. Deb. ...	123—128	...	126½—127½
250,000	,,	,,	4	4	Do. 4 p.c. Deb. ...	105—110	...	...
647,740	,,	Aug. 12	5	5	Southampt'n Ord. 5 p.c. max.	115—120	...	...
121,275	,,	June 7	4	4	Do. 4 p.c. Deb.	100—105	...	...
350,000	,,	Aug. 12	5½	5½	Swansea 5½ p.c. Red. Pref. ...	113—118	...	116
200,000	,,	June 7	6½	6½	Do. 6½ p.c. Red. Deb. ...	98—103	...	101—102½
1,076,490	,,	Aug. 12	6¾	6¾	Tottenham and District Ord.	149—154	...	149½—150
409,835	,,	,,	5½	5½	Do. 5½ p.c. Pref. ...	130—135	...	...
62,235	,,	,,	5	5	Do. 5 p.c. Pref. ...	120—125	...	...
334,615	,,	June 7	4	4	Do. 4 p.c. Deb. ...	101—106	...	...
369,774	,,	Aug. 12	7	7	Uxbridge, &c., 5 p.c.	150—155	...	...
108,330	,,	,,	5	5	Do. 5 p.c. Pref. ...	118—123	...	...
1,326,700	,,	Aug. 12	7	7	Wandsworth Consolidated ...	156—161	+1	158—160
1,371,373	,,	,,	5	5	Do. 5 p.c. Pref. ...	121—126	...	125
1,317,964	,,	June 7	5	5	Do. 5 p.c. Deb. ...	125—130	...	...
338,300	,,	,,	4	4	Do. 4 p.c. Deb. ...	102—107	...	...
158,400	,,	Aug. 12	6g	5	Winchester W.& G. 5 p.c. Con.	114—119	...	...

Quotations at :—*a*.—Bristol. *b*.—Liverpool. *c*.—Nottingham. *d*.—Newcastle. *e*.—Sheffield. *f*.—The quotation is per £1 of Stock. *g*.—Paid £3, including 10s. on account of back dividends. * Ex. div. † Paid free of income-tax. ‡ For year. § Actual for three months.

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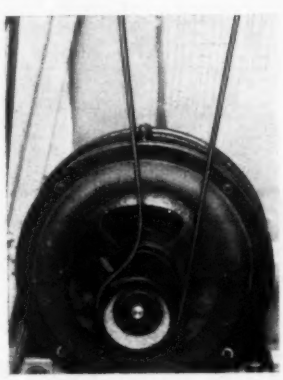

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